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Note: Becky Marty has an original and complete copy at Itasca Park Headquarters

AN ANALYSIS OF THE MAINTENANCE OF PRE-SETTLEMENT BIOTIC COMMUNITIES AS AN OBJECTIVE OF MANAGEMENT IN ITASCA STATE PARK, MINNESOTA

A THESIS

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CHAPTER 7

THE BIOTIC COMMUNITIES OF ITASCA STATE PARK AS THEY EXISTED IN 1891

In this study we are concerned with the ecologic conditions which existed in 1891 when Itasca State Park was formally established. It was the conditions which prevailed in the area at that time which the early park proponents sought to preserve. This date does not precede the first visit to the area by white man. It does, however, pre-date the first instance of major influence on the natural communities by European man. The makeup of the natural communities was not greatly disturbed until logging operations began in 1903 (Dobie, 1959). It should be pointed out that for the purposes of this study the influence of the American Indian and his predecessors is to be considered natural.

7.1 Techniques for determining early community composition

7.11 Descriptions by early observers

The diaries and journals of early explorers and travelers can provide many clues to the character of the pre-settlement forest. The usefulness of this information depends upon the number of people who

visited the area in question and the accuracy and detail of their descriptions. Generally, a single diary or journal provides only a limited amount of information on a small area. However, when many reports are combined a fairly complete picture of the landscape can be constructed.

Reports of early visitors to the Atlantic coast were used by Hawes (1923) to develop an idea of the composition of the original forests of New England. The journals and books which Hawes reviewed dated as far back as 1634. Hawes was able to document the species composition of the early forest and the physical character of the vegetation as influenced by Indian-caused fires.

Habeck and Curtis (1959) used similar techniques of historical research to investigate the nature of the deer populations and habitat in northern Wisconsin prior to the 1850's. They found these early forests to be a mixture of types resulting from numerous natural catastrophies. This mixed forest would have provided excellant deer range, unlike the previously held conception of a virgin forest of mature conifers.

Cooper (1960) made considerable use of reports by contemporary observers to reconstruct a picture of the forests of southwestern United States before settlement. He also obtained information on the early game

populations in that area.

A report on the early forest conditions of interior Alaska was published by Lutz in 1963. This report was based almost entirely on the journals, records and publications of early explorers, geologists, military officers and scientists. Lutz's work is perhaps the best available demonstration of the utilization of descriptions by contemporary observers to reconstruct a historical record of the forests of the past.

Both historical narrative and photographic evidance were used by Gibbens and Heady (1964) to study the influences which modern man has had on the vegetation of Yosemite Valley in California's Yosemite National Park. Descriptions of the ecologic conditions in the Valley were obtained from the journals of visitors to the area and from early reports by park personnel. The changes which have occurred in these conditions, particularly in the amount of open meadows, were determined by comparison of recent photographs with pictures included in the early reports and files.

Only one example could be found of the use of historic literature to document the character of past landscapes in the Itasca Park area of Minnesota. Spurr (1954) made some use of descriptions from explorers journals in his paper on the fire history of the Park. The uniqueness of the area as the source of the

Mississippi River resulted in a considerable number of visits to Itasca by early travelers. Chapter 6 documents this series of visitors beginning in the 1600's with the French fur traders. Nearly all of the adventurers in search of the "true source" of the Mississippi have left us with journals or published accounts of their travels. Many of these documents contain references to the landscape at or in the vicinity of Itasca State Park. These references, when taken collectively, give us a good general picture of the forests of Itasca prior to 1891. A current place name map of Itasca Park is presented in Figure 4 for comparison with the historical reports and maps discussed on the following pages.

Henry R. Schoolcraft provides us with the first information on the character of the natural scene in the Itasca area (Figure 5). In the narrative of his trip to Itasca in 1832 he describes the area east of the east arm of Lake Itasca as "small forest growth, by far the most common species being the scrubby pinus banksiana" (Schoolcraft, 1855). Lieutenant James Allen who accompanied Schoolcraft likewise noted that this portion of their journey was "over pine ridges of the poorest character imaginable. The soil was almost pure sand and the pine was stunted and mostly of the scrub species (Pinus banksiana)" (Mason, 1958).

area in only the vaguest manner. In his description of the land surrounding Lake Itasca he stated:

> These elevations are commonly flat at top, varying in height from 85 to 100 feet above the level of the surrounding waters. They are covered with thick forests, in which the coniferous plants predominate.--Nicollet, 1843.

Julian Chambers, who visited Itasca in 1872, left oneof the most complete descriptions of the area (Figure 6). Chambers and his party reached Lake Itasca by paddling up the Mississippi River. As he entered the Lake he noted:

> The prospect from the outlet, looking eastward...is not thrilling. The north arm of Itasca is half a mile broad and its eastern shore rises to a bluff of twenty-five feet. At the time of my visit, it had a background of softwood trees, with a few pines. The loneliness of the entire landscape was appalling.--Chambers, 1910.

This description possibly indicates that the area immediately east of the north arm had been recently burned. The "softwood trees" could very well have been aspen and birch which arose following a fire. The "few pines" would be the remnants of the earlier stand.

Chambers explored Lake Itasca quite thoroughly. While in the east arm he noted that on the western shore "was seen the finest timber between Itasca and

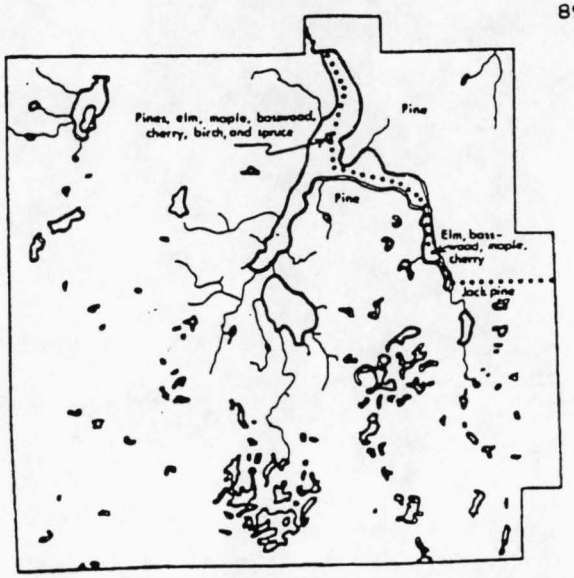

Figure 5. Forest cover as described by Henry R. Schoolcraft, 1832.

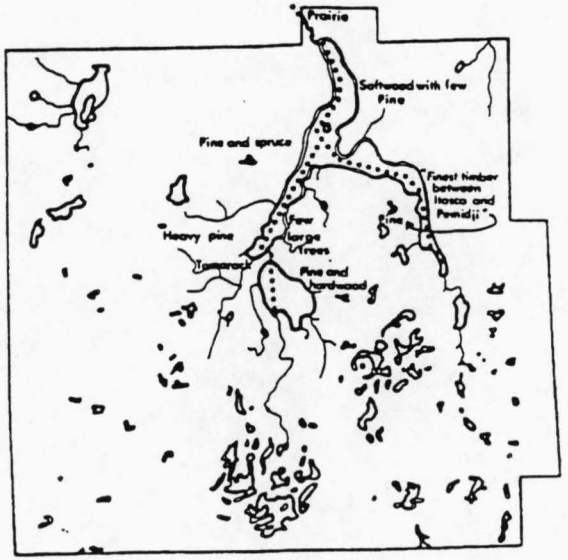

Figure 6. Forest cover as described by Julian Chambers, 1872.

Pemidji [Bemidji]." This observation is of considerable interest since this shoreline now supports only a discontinuous fringe of pine. This would seem to indicate, as Spurr (1954) mentions, that some natural catastrophy destroyed the stand of pine seen by Chambers in 1872.

The east shore of the west arm was described by Chambers as having "reed-grown characteristics similar to those of the western beach of the east arm. The bluff is the same height, but large trees appeared fewer" (Chambers, 1910).

Chambers portaged from the west arm into Elk Lake and paddled to the "western bay" where he explored a creek which entered at that point. He found that "the forest in that locality is so thick that I could not see the 'Heights of Land' lying to the southward."

Julian Chambers was the first explorer in the area to publish maps of Itasca which identify the native vegetation. These maps are reproduced in Figures 7 and 8.

After Julian Chambers there were several visitors to Itasca who contributed nothing to our knowledge of the contemporary vegetation of the time. The next good source of information is O. E. Garrison, who

Figure 7. Sketchmap of Itasca Lake by Julian Chambers, 1872 (Brower, 1893).

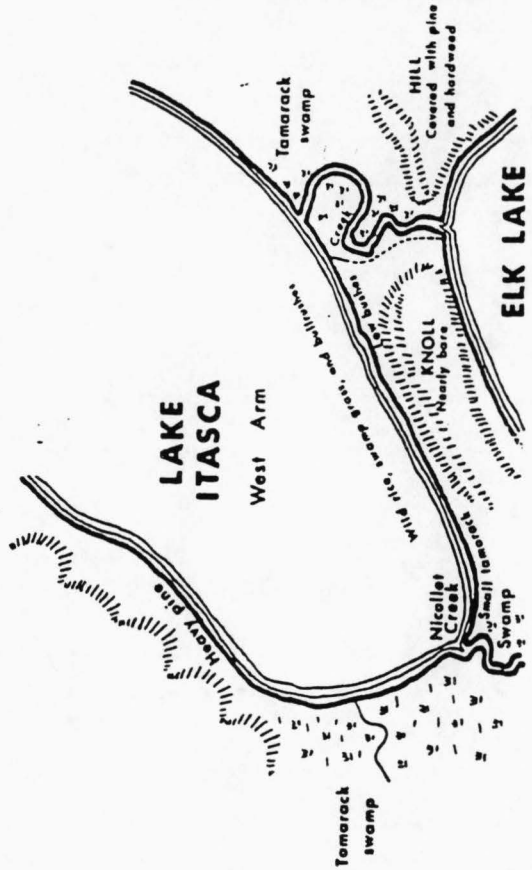

Figure 8. Sketch map of area between Lake Itasca and Elk Lake (Chambers, 1910)

examined the area in 1880 for the Geological and Natural History Survey of Minnesota. Garrison entered the Itasca basin from the south (Figure 9), traveling to Hernando de Soto Lake "through dense woods of black /jack/ and Norway /red/ pine with hazel, alder, willow, and aspen undergrowth" (Garrison, 1881). From DeSoto Lake, he portaged to Morrison Lake and then paddled to the head of a trail leading north. From Morrison Lake the party moved to a small pond (probably the southwestern-most of the Triplet Lakes). There they rested, "dining among some large Norway and white pines, with oaks, basswood, maple, etc." From Triplet Lakes, Garrison's party continued north to Whipple Lake and Floating Moss Lake where they again struck a blazed trail.

> The trail was easily followed through the swamp, but after leaving the swamp and beginning to ascend a low hill we entered a dense tall growth of birch, aspen, oak, pine, etc., the ground thickly strewn with the remains of a large growth of pines, many of them still pretty sound, showing there was, but a few years ago, a large pine forest here. To the north about half a mile was seen a grove of Norway pines, still alive, through which it seemed that it would be easier to cut our trail.--Garrison, 1881.

At this point, Garrison camped, probably on the south edge of the old-growth red pine stand which now surrounds Nicollet Cabin. The following day the party

continued northward until they were about a quarter-mile south of Elk Lake. There Garrison climbed a tree on a hill-top (possibly the hill just south of Hall Lake) and described the surrounding countryside.

> For many miles in all directions but the north the surface was gently rolling, none of the hills appearing to be more than twenty or twenty-five feet high; they were chiefly covered with a young growth of birch, aspen and a few oak. Towering above them were seen the black pines, not killed by fires, and an occasional single tree or small groves of Norway pine, towering still above these.--Garrison, 1881.

From this vantage point, Elk Lake, directly to the north, was "concealed by a grove of Norways."

Upon reaching Elk Lake, Garrison crossed it to Chambers Creek and portaged overland to Lake Itasca. There his narrative continues:

> We paddled slowly along the west shore of the northeast arm, stopping occasionally to identify trees. The arm of the lake towards its southern extremity is surrounded by comparatively high hills, the highest probably 75 feet above the lake. The western shore is badly burned, with but few pine trees standing, and the dense new growth of birches and aspens among the fallen trees makes it a very difficult tract to traverse. The eastern is much less devasted by fire. There is some good pine on the sides of the hills which, near the southern extremity may reach 100 feet above the lake.--Garrison, 1881.

Garrison's description of the west and east arms is much more brief.

> The shores of the southwestern arm are low, 10 to 15 feet high, and closely fringed with spruce, cedar, balsam fir, and tamarack. Some boulders were seen, while the east side of the southeast arm is lined with rocks, and with the side hills quite covered with fair sized white and Norway pines.--Garrison, 1881.

As the Garrison party left Lake Itasca and entered the Mississippi River, Garrison described the country adjacent to the outlet as being "low and level and brushy, bordered with prairie country with a few black pines."

Garrison's journal is considerably more detailed than those of any of his predecessors and thus provides us with an excellent view of the forests of Itasca in 1880. His report documents the existence of stands of old-growth red and white pine in the Nicollet cabin area and on the east shores of the north and east arms of Lake Itasca. Remnants of an old pine stand is mentioned in the area immediately north of Floating Moss Lake. The description would seem to indicate a decadent stand which was blown down in a severe wind storm. Another old-growth remnant is identified on the west shore of the north arm. This stand was evidently destroyed by fire at some later date.

Another indication of fire is found in the description of the jack pine - red pine mixed stand south of Hernando de Soto Lake. Mixed stands of this nature

frequently are regenerated after a burn and maintain their mixed nature for 75 to 100 years at which time the jack pine component drops out of the stand (Spurr and Allison, 1952). This would imply that the stand mentioned by Garrison was less than 100 years old. At present the cover type in that location is red pine dating from the fire of 1820. This stand would have been about 60 years old when Garrison passed through it.

Fire-type sub-climax forest is also identified by Garrison in the area southeast of Elk Lake. He describes this forest as young second-growth aspen and birch with scattered jack and red pines.

Six years after Garrison's visit to Itasca, Hopewell Clarke, a surveyor for the Northern Pacific Railroad, arrived in the area to further study the geography of the source of the Mississippi River (Dobie, 1959). Clarke traveled to Itasca by wagon from Park Rapids, striking the lake first at the southeast arm. The Clarke party then went at once to the southwest arm which was described in Clarke's journal.

> We are looking southward; and to the right the shore of the lake is lined with pine, while the left shore and all the upper (southern) end is bordered with tamarack, except for a few bushes and some rice grass.--Clarke, 1886.

Clarke's description of the southwest arm agrees

with earlier reports by Garrison and Chambers. It is interesting to note that the "small, bare, mound-like elevation or knoll" between Lake Itasca and Elk Lake (Morrison Hill) is now covered by a dense cover of aspen and balsam fir.

The next source of information on the early vegetation of Itasca Park is the report by Jacob V. Brower of his expedition to Itasca in 1888 (Figure 10). His first description is of the land adjacent to the outlet of the river at the north end of Lake Itasca.

> The great river, on its course northwest from Itasca Lake was visited and found to be an ordinary stream of no special pecularities, with willow thickets, balsam-fir groves, a range of hills on either side and the surroundings ordinarily attendant in a pine region. Fire had matarially destroyed the growth of pines and many hills were nude; underbrush, old fallen and burnt timber, and a general air of an uninhabited wilderness prevailed.--Brower, 1893.

Brower provides us with about the only description of the land west of Lake Itasca and away from the shore.

> From the west shore of Itasca Lake there is a gradual rise in the elevation of the surface, for two or more miles until the summit of the Hauteur de Terre is reached, which divides the waters tributary to Hudson's Bay and the Gulf of Mexico. The elevation of this summit above the surface of Itasca Lake averages about two hundred feet, broken and hilly, irregular in formation, and is covered with a dense growth of timber, principally pine of different varieties.-- Brower, 1893.

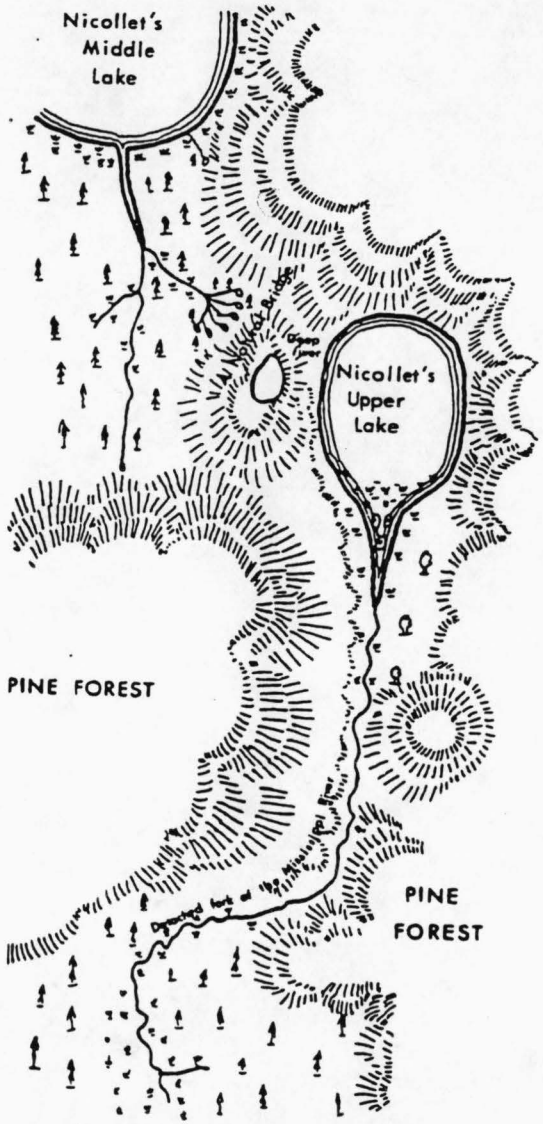

Figure 11. Sketch map of Natural Bridge between Nicollet's Upper and Middle Lakes (Brower, 1892).

Figure 12. Sketch map of Mississippi Springs and Whipple Lake by J. V. Brower, 1895.

Nicollet Creek valley (Garrison, 1880 and Brower, 1888) and on various parts of the Lake Itasca shoreline including the west shore of the east arm (Chambers, 1872), the east shore of the east arm (Garrison, 1880), the west shore of the west arm (Clarke, 1886) and the east shore of the north arm (Garrison, 1880)[1/]. Old-growth pine is still present at each of these locations, with the exception of the west shore of the east arm. Perhaps Chambers was describing the east shore of the east arm where there is old-growth timber today, instead of the west shore. If not, then his claim that this was the "finest timber between Itasca and Pemidji" may be an exaggeration or the stand may have been destroyed sometime after 1872 by either wind or fire as Spurr (1954) concluded. At present, only a thin fringe of old pine is to be found in several spots immediately adjacent to the lake. The red pine stand reported by Clarke on the west shore of the west arm is still present but has suffered some damage from wind storms.

Many of the stands reported to be in early successional stages (post-fire succession) have now either reached maturity and broken up or have re-burned and again support an early stage in the secondary succession

1/ The dates used in this paragraph are the year of observation and not the year of the published paper.

sequence (aspen, birch or jack pine). As an example, the area east of the north and east arms of Lake Itasca today supports a jack pine forest (with some red pine) probably quite similar in appearance to that seen by Schoolcraft in 1832, Nicollet in 1836 and by Chambers in 1872. The present trees in this area are 70 to 80 years old and apparently became established following fires in 1889, 1891, and 1895. These fires would have destroyed most of the stands seen by the early travelers. The jackpine - red pine forest reported by Garrison south of DeSoto Lake is now 140 years old. The jack pine component of this stand has almost completely broken up and the stand is now nearly pure red pine.

Garrison (1881) reported that in 1880 the area around the Mississippi River as it leaves Lake Itasca was "bordered with prairie country with a few black /jack/ pines." This description was corroborated by Brower in 1888. Today this same area supports a rather dense stand of 70 year old jack pine which regenerated after the fire of 1895. The seed for the present stand very likely came from the "few black pines" which Garrison noted.

7.12 The Government Land Office Survey

Land Survey notes have frequently been used to

reconstruct a picture of early vegetation. Work of this kind has been carried out extensively in Michigan beginning as early as 1929 (Kenoyer, 1929, 1933, 1939 and 1942). These studies used notes from surveys in the early 1800's. Similar studies have been conducted by Sears (1925) in Ohio, Lutz (1930) in Pennsylvania, Fassett (1944) and Stearns (1949) in Wisconsin, Blewett and Potzger (1950) in Indiana, and by Gordon (1940) and McIntosh (1962) in New York.

Bourdo (1956) published an extensive review of the land survey as a key to the nature of former forests. In this report Bourdo provides several guidelines and cautions in the use of land survey records.

In the Itasca area, McAndrews (1966) used land survey notes to reconstruct a picture of the presettlement vegetation along an east-west line across the prairie-forest border. A portion of this line fell within Itasca State Park.

Most of what is now Itasca State Park was surveyed in 1875 by Edwin S. Hall. The remaining portions were completed in 1878 and 1879. These survey notes contain two types of information which are useful in determining the nature of the vegetation in the 1870's. The notes contain a description of the diameter and species of each tree blazed and scribed to witness a section or quarter-section corner. The notes

also indicate the bearing and distance each witness tree lies from the corner. Four witness trees were so located at each section corner, one in each of the four adjacent sections. At each quarter-section corner, two witness trees were located, one in each section. This information provides us with a general picture of the species present at each corner. In addition, at the end of each mile of line, the surveyor wrote a general description of the forest which that line segment passed through. As an example, one description from Itasca Park reads:

> Land rolling, 3d rate. Timber black pine. Scattering of norway and white pine. Birch and aspen. Dense undergrowth of hazel, aspen and alder.

These descriptions, although quite general, do give us some indication of the nature of the vegetation.

Figures 13 and 14 show the vegetation patterns which existed in the period 1875 to 1879 as nearly as can be determined from the land survey notes. Figure 13 was prepared using the general descriptions of vegetation encountered along the section lines. It was assumed that species were listed by the surveyor in the order of their prevalence. This was the manner in which such data were supposed to be recorded (Bourdo, 1956). Each line description was recorded on a map of Itasca Park. The various descriptions were then mapped

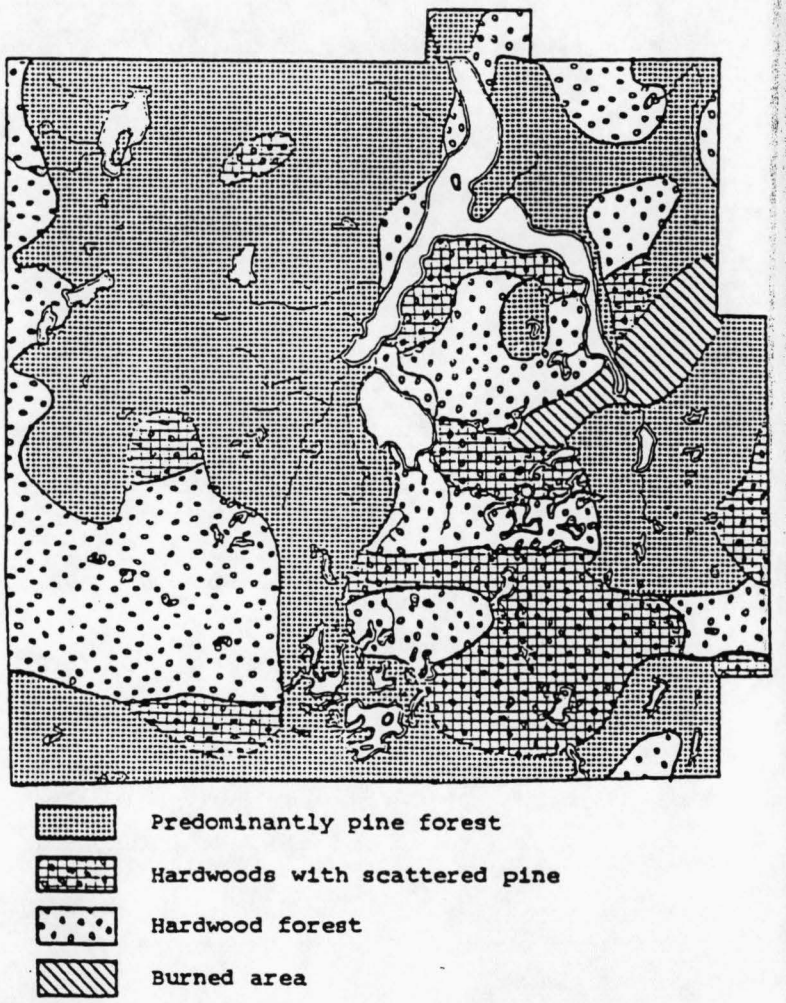

Figure 13. The forest cover of Itasca State Park as reconstructed from the general vegetation descriptions in the field notes of the land survey, 1875-1879.

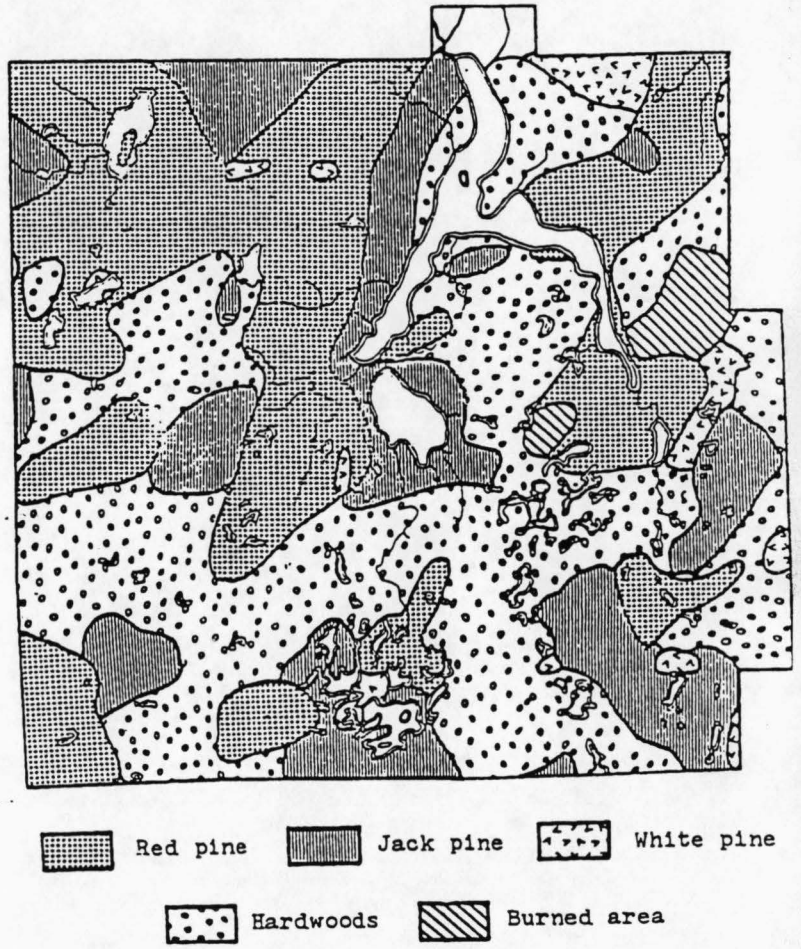

Figure 14. The forest cover of Itasca State Park as reconstructed from the witness tree descriptions in the field notes of the Land Survey, 1875-1879.

into three broad groupings; 1) areas where pine was listed as predominating, 2) areas where pine occurred as a secondary species (probably scattered within hardwood types) and 3) areas which were predominantly aspen-birch. This technique provides us with a generalized map of the distribution of the pine stands in 1875.

A more detailed map has been prepared using the witness tree species data (Figure 14). In this case the occurrence of each species of tree was recorded as colored dots at the appropriate section and quarter-section corners. Areas containing similar colors (species) were then enclosed by a line to roughly delineate the type boundary. Several points of caution must be noted. First, the type boundaries as shown in Figure 14 are only approximately located, generally by drawing the lines half-way between a corner where the species occurred and an adjacent corner where it did not. Secondly, as noted by Bourdo (1956), the use of witness trees as an indicator of type occurrence is subject to species bias. Certain tree species may have been favored by the surveyor because they were more easily blazed and scribed. In this project, only a general type map has been attempted. If the exact detail of the map is of concern, other techniques such as contemporary observations, timber survey data, and

observations of currently existing natural stands can be used to validate the pre-settlement vegetation patterns as reconstructed from the land survey data.

7.13 Timber Survey data

Jacob V. Brower, the first Itasca Park Commissioner, carried out an extensive timber survey to evaluate the lands which the State wished to purchase for the Park. This survey was conducted in 1899 and 1900, some nine years after the 1891 restoration target date previously selected for this study. However, little activity other than limited homesteading had taken place within the present park boundaries by 1900. Consequently, the forest conditions at that date were little changed from those in 1891 when the Park was established. The data from Brower's 1899-1900 survey can thus be considered applicable to this study.

The Timber Survey contains general descriptions of each section in Itasca Park which, at that time, was only about 70 percent of its present size (Figure 15). In addition to these general descriptions, most of the individual forty-acre subdivisions were described in detail. Particular emphasis was placed on the location and volumes of red and white pine. This information has been plotted on a map of the Park and

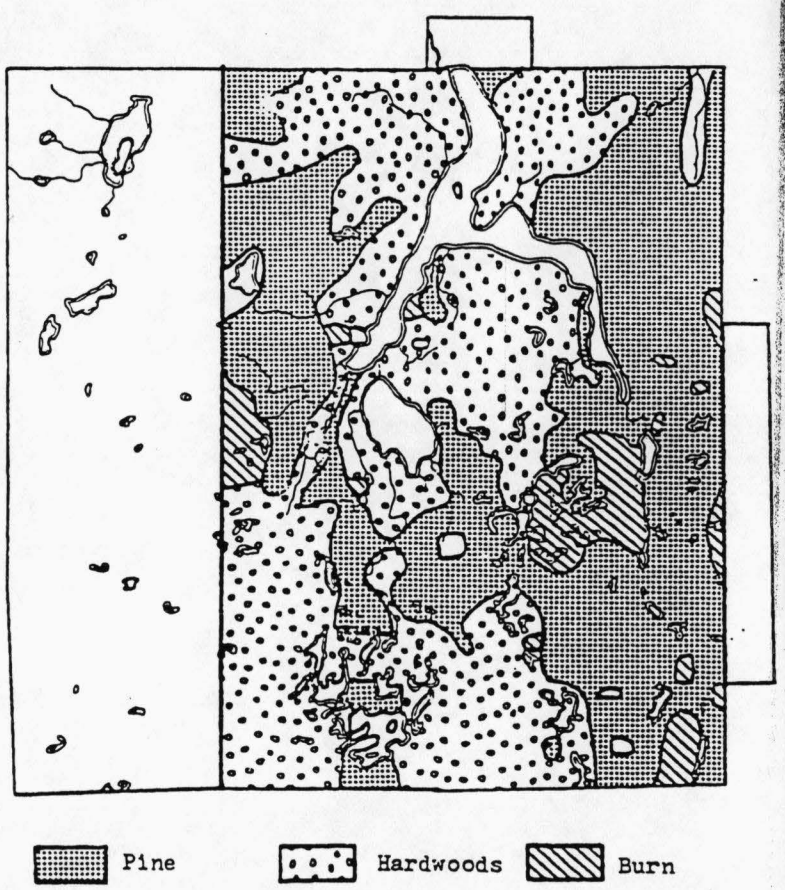

Figure 15. The forest cover of Itasca State Park as reconstructed from descriptions in J. V. Brower's timber survey, 1899-1900. (Blank area at left was logged prior to acquisition as part of park.)

the boundaries of the various types have been drawn as accurately as possible. Three vegetation types are shown: red and white pine, hardwood (including aspen, birch, tamarack, cedar, and swamp types) and burned barrens.

The overall pattern of vegetation in 1900 appears much the same as it was in 1875 when the land survey took place. The 1900 map shows somewhat more extensive areas of red and white pine in the eastern portion of the Park. According to Brower (1900) much of this area was "recently burned over," probably by fires in 1891 and 1895. He lists many portions of the area east of the east arm of Lake Itasca and northeast of Mary Lake as "pine barrens" or areas nearly devoid of timber (Plates 1 and 2). These fires may have reduced the aspen and birch cover on those areas which were noted as hardwoods in the 1875 land survey. Scattered pine trees could have survived these fires and would thus have placed the burned-over areas into the category of pine stands as classified by Brower. The locations described by Brower as "pine barrens" were also noted in the 1875 survey as burned, perhaps by fires in 1871 and 1875. This portion of the Park, with its sandy soil, has long supported a jack pine stand which, when destroyed by fire, has succeeded in regenerating itself. Currently, this

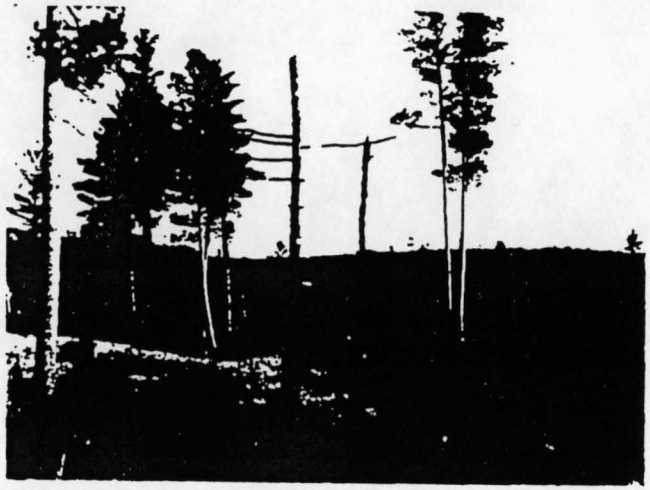

Plate 1. "Pine barrens" as described by Brower, 1900

Plate 2. Burned-over pine lands covered by aspen sprouts. (Brower, 1900)

area is occupied by a stand of mixed red and jack pine which dates from the 1895 fire (70 to 72 years old in 1967).

Brower describes the land east and west of the north arm of Lake Itasca as covered with an aspen-birch-fir mixture similar to that noted in the 1875 survey and by Chambers in 1872.

7.14 Current ecological evidence

Much of Itasca State Park was acquired by the State of Minnesota before the forest was affected by modern activities such as logging. Consequently, the Park now contains a considerable acreage of the natural forest as it existed in 1891, except for the removal of dead and down trees.. The distribution of pine stands in this present-day forest is illustrated in Figure 16 as derived from a 1967 vegetation cover map (Meyer, 1967).

Several differences exist between this forest and the pre-1900 forest. Several areas of pine were logged between 1900 and 1920. The largest of these areas is a two-mile wide north-south strip on the western edge of the Park. At the time of logging this unit was not officially part of the Park. The area is conspicuous on the current vegetation map by its relative lack of pine forest. Much of the area

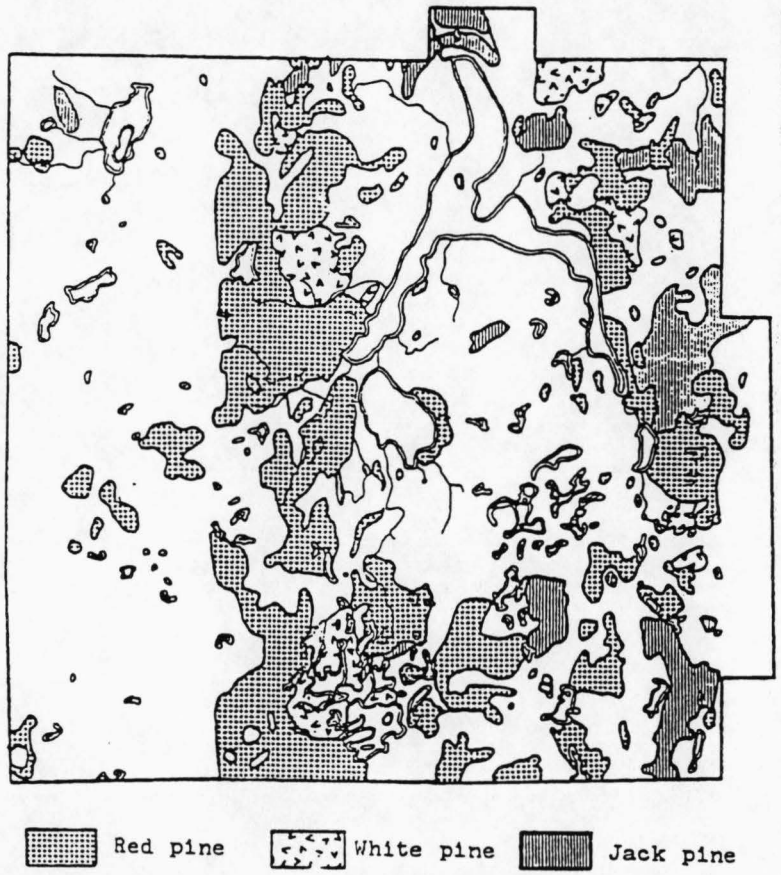

Figure 16. The distribution of pine forest in Itasca State Park, 1967. (After Meyer, 1967)

south of Elk Lake, in the southeastern corner of the Park, and the northeastern portion east of the north arm were also logged. These areas are also recognizable on the current type map. Another major consideration in the difference between current forest cover and that of 1900 is that fire has been essentially prevented in the Park since 1920. Consequently, the areas described in 1899 as "pine barrens" (Brower, 1900) no longer exist. Also, the young stands of red pine, jack pine, aspen and birch which were commonly noted before 1900 have grown up and are now 70 to 100 years old.

Some of the stands which were in the older age classes in the 1800's have since become decadent and have broken up. In pre-settlement times fire would have regenerated many of these stands. Since fire has been excluded for the past 60 years most of the stands of pine which have broken up have been replaced by hardwood types. These changes will be discussed in greater detail in Chapter 8.

7.2 Description of the biotic communities in Itasca State Park in 1891

The purpose of all of the various procedures described above is to provide sufficient information to allow us to determine the nature of the biotic communities which existed in Itasca when the Park was

established in 1891. Each of the various investigative techniques provides more details or a slightly different view of the early forest.

The term "biotic community" by definition includes both the flora and fauna. Since animals are dependent on vegetation for food and cover, it is desirable that we determine the nature of this vegetation first. Then the wildlife present in 1891 can be determined on the basis of actual evidence and by hypothesis concerning the wildlife species which might have inhabited such plant communities as existed in 1891.

Our concern in this study is not with specific locations of the vegetation types and how to restore and maintain these types in precisely the same locations. We are interested in determining what variety of communities existed in 1891, how they interacted, and what factors were responsible for their maintenance. In other words, we wish to be able to preserve and, where necessary, restore the ecological relationships which existed in 1891 and thus retain the variety of naturally interacting biotic communities.

Examination of the information available from the historical literature and from the various surveys immediately leads to the generalization that the pre-settlement forests of Itasca State Park were not vast,

unbroken stands of virgin pine. On the contrary, every journal and survey reviewed contains evidence that these early forests were diverse in species composition and in age structure (Figures 5 through 12).

In 1832 Henry R. Schoolcraft saw a stand of small jack pine east of the southeast arm of Lake Itasca, pines on the hills around the lake, and elms, basswood, maple and cherry near the shores. Julian Chambers, on his visit in 1872, observed large old-growth red pine on the west shore of the east arm of Itasca. In 1880, O. E. Garrison noted a dense stand of red and jack pine with hazel, alder, willow, and aspen undergrowth south of DeSoto Lake. Garrison also reported old-growth pine in the Nicollet Creek valley, a decadent and devasted old-growth pine stand near Whipple Lake, and a young forest of aspen and birch with scattered older pine south and west of Elk Lake. In 1899 Brower observed recently burned areas with scarcely any tree cover at all except widely scattered pines.

The more detailed information from the 1875-79 land survey, from Brower's timber survey of 1899-1900, and from current examination of remnants of the natural forest supports this picture of the pre-settlement Itasca Park area as a patchwork pattern of pine and

hardwood stands of varying ages, in some areas with dense understories of hazel, alder, willow, and aspen. These stands were intermixed with smaller areas of tamarack, balsam fir, bog, treeless open prairie and jack pine savanna (Figures 13 through 16).

Evidence available from early journals and surveys indicates that the pre-settlement Itasca area was also diverse in respect to the animal component of the biotic communities.

The most complete picture of the wildlife which inhabited the Itasca area before settlement comes from the journal of Jean Nicollet (1843). He stated that the Chippewa Indians visited the area to hunt "bear, deer, elk, wolf, fox, wolverine, fisher, raccoon, muskrat, mink, otter, marten, weasel, and a few remaining beavers." Nicollet also noted that "the American moose still occasionally makes its appearance." Brower (1893) reported that in the Nicollet Creek area "the mink, otter, and muskrat abounded, and wild ducks of many northern varieties were from time to time noticed...."

In his report to the Governor in 1894, Park Commissioner Brower wrote:

> The past year I have taken active steps to protect the game and fish within the limits of the reservation, with some success. Much more could have been done if the use of firearms was entirely prohibited there. In 1893 Indians and pot-hunters roamed all over the park, killing every animal and fowl they came to. Moose, deer, and bear suffered the common slaughter.

Brower further noted that "moose meat has been more plentiful than beef." These statements would seem to indicate that in the 1890's moose was a rather common inhabitant of the Itasca area.

Several of the animals mentioned by Nicollet are now missing from the area. Elk are no longer native to Minnesota except for a small introduced herd in the Upper Red Lake area. Wolverines are supposedly completely extirpated from Minnesota, although there have been some reports of recent sightings. Wolves, fisher, and marten are now found only in the far northern portions of the State. Moose are quite rare in the immediate vicinity of Itasca but have been seen occasionally in recent years.

Most of the animals which have been extirpated from the Itasca Park region are those so-called "wilderness" species which for various reasons cannot survive in settled areas. Some of these animals, such as the wolf and elk, were eliminated largely because they were not tolerated in areas of agricultural and livestock production. Simply stated, elk ate crops and wolves ate livestock.

It is unfortunate that many of the extirpated species are predators. It is partially because of the lack of wolves, wolverines, marten, and fisher (recently reintroduced) that we currently have problems with excessively large populations of deer and porcupine.

In their list of mammals currently found in Itasca State Park, Sargent and Marshall (1959) mention several animals which were not mentioned by early explorers. Chipmunks, tree squirrels, flying squirrels, snowshoe hare, cottontail rabbits, coyotes, striped skunk, and bobcat are currently found in Itasca and probably were present before settlement. Ground squirrels and woodchuck which are now present may have migrated into the Park since settlement took place.

There have been no reports of the presence of cougar in the Park. However, its original range would have included this area. In fact, the last cougar to be killed in Minnesota was taken in 1897 just west of Itasca in Becker County (Gunderson and Beer, 1953).

The goal of this study is to examine the application to Itasca State Park of an active management policy aimed at maintaining and, if necessary, restoring the pre-settlement biotic communities. As the investigations discussed above indicate, if the active

management policy were adopted, the condition which we would seek to maintain or restore in Itasca would be one of diversity in biotic communities. The objective of management would be to preserve the variety in community composition, maintaining the patchwork design on uplands of pine forests, hardwoods, savannas and even some grasslands and of marshes, meadows, bogs, and swamps in the lowlands. Additionally, and most important for the long-term maintenance of this natural pattern, would be the restoration of the wide range of forest stand age classes which was prevalent in the pre-settlement Itasca region.

CHAPTER 8

THE IMPORTANCE OF FIRE AS A NATURAL ECOLOGICAL FACTOR IN ITASCA STATE PARK

The forests of the Itasca area before settlement were composed primarily of a mixture of aspen and birch with red, white, and jack pine stands (Chapter 7). The most recent vegetation cover map (Meyer, 1967) indicates that this is still the case. These so-called "sub-climax" species have several ecological characteristics in common. They all are rather intolerant to shade. In addition, the seeds of these species germinate most successfully on mineral soil. Within a mature aspen-birch or pine stand the conditions requisite for regeneration of these species are frequently lacking. Those pine seedlings which do develop generally soon die from drought as their slow-growing root systems attempt to penetrate the organic material and reach moisture sources in the mineral soil. The shade cast by the overstory trees seriously inhibits the growth of aspen-birch and pine seedlings and frequently results in their death.

Because of the unfavorable environment, a stand of aspen, birch, red pine, white pine, or jack pine can seldom reseed itself on an undisturbed site. Species with seedlings which can become successfully

established on organic material and which are shade-tolerant generally begin to develop on the sites occupied by aspen-birch and pine stands. In time the site is taken over by these species. In the Itasca Park area aspen, birch, and pine are frequently succeeded by ironwood (Ostrya virginiana), red maple (Acer rubrum), sugar maple (A. saccharum), basswood (Tilia americana), and red oak (Quercus rubra) or by an intermediate shrub stage which is then followed by hardwood species. In some situations white spruce-balsam fir stands may develop (Buell and Martin, 1961; Buell, 1956; and Buell and Gordon, 1945).

In pre-settlement times this successional trend toward climax northern hardwoods or spruce-fir species was arrested by periodic natural catastrophies. These catastrophies created the conditions necessary to obtain successful regeneration of aspen, birch, and the pine species. It is these natural disturbances which account for the mixture of types and variety of age classes typical of the forests of Itasca State Park. Thus, it seems inevitable that if we are to attempt to restore some semblance of pre-settlement biotic communities and ecological relationships in Itasca, then we must insure perpetuation of the periodic disturbances which are so critical in the creation and maintenance of sub-climax communities.

In the pre-settlement forest the most prominant factors responsible for catastrophic disturbances were wind, insects, disease, and fire. All of these factors have no doubt affected the forests of Itasca Park. With the exception of white pine blister rust, a recently introduced exotic, there is no record available of major insect or disease epidemics which would have seriously affected the successional patterns in Itasca. Catastrophic winds have been reported in the Park both in the early years and in recent times. For example, Brower (1904) stated:

> During the month of August, 1900, the park was visited with a heavy rain and wind storm, which felled to the ground from thirty to forty thousand feet of pine timber.

This blowdown occurred in the extreme southeast corner of the Park.

A severe windstorm could cause considerable damage to overstory trees in aspen-birch and pine stands. This blowdown, ranging from a removal of individual trees to the destruction of sizeable areas of forest, could result in increased light availability at the forest floor. This increased light could then stimulate the growth of seedlings. However, wind throw could provide the necessary mineral seed beds only in the spots where the soil was turned over. This slight disturbance of the organic soil cover could hardly

result in the perpetuation of extensive even-aged stands of sub-climax species. It thus would appear that wind has not been the major factor controlling the occurrence of these stands in Itasca. The only remaining form of disturbance to be considered is fire.

Maissurow (1941) carried out an extensive study of the effects of fire on the virgin forests of northern Wisconsin. He noted that 95 percent of the virgin forests had been burned by fire within the last five centuries. Maissurow concluded that these fires were not "conflagrations of catastrophic proportions which destroyed the primeval forest and changed its climax formations into subclimax types of the present era." He described the more likely situation of "periodic and ecologically normal events in the life of the forest."

After a detailed analysis of the reproduction, composition, and age structure of 22 virgin stands, Maissurow concluded that

> Fires have been necessary factors or agents in the perpetuation of a number of species, such as yellow birch, hemlock, pines, and intolerant hardwoods, thus shaping and determining the form and composition of the forest.

Maissurow (1941) made the importance of fire in the northern forests very clear. This fact had not

been emphasized in earlier studies. In the Itasca area, research carried out by Lee (1924) and Kell (1938) had concentrated on the nature of the climax forest communities and the relation of subclimax species distribution to soil texture. While fire received passing mention, it was considered only as a deterrant to the attainment of the true climax and as such not worth further study. Spurr (1954) was one of the first to give recognition to fire as a major ecologic factor in the forests of the Itasca area. More recently, Ahlgren and Ahlgren (1960) prepared an extensive review of the literature on the ecological effects of forest fires. The evidence they have summarized further substantiates the importance of fire in the establishment and development of even-aged stands of pine, aspen, and birch.

In consideration of the apparent significance of fire in shaping the pre-settlement forests of the region, a major portion of the field work carried out in this early phase of the Itasca Management Project has been devoted to detailed documentation of the role of fire in Itasca Park. This work has resulted in data on fire frequency, areal coverage of individual fires, and the effects of fire on the age structure of the forest.

8.1 Causes of wildfire in pre-settlement forests.

The North American wilderness as it existed before the coming of European man has frequently been described as an endless expanse of undisturbed virgin forest. It has become increasingly evident, however, that this is not an accurate representation of the situation. In fact, much of the so-called "virgin" forest was subject to and, indeed, dependent upon disturbance. While these disturbances were of many types, we will again concentrate on the importance of only one factor—fire.

Cooper (1961) and many others have pointed out that for centuries before European man entered the picture fires had periodically burned over much of North America.

Currently, we commonly classify fires as man-caused or natural. This classification can be misleading, since many early fires were caused by Indians and we are considering the Indian as a part of the natural wilderness ecosystem. Consequently, in this study we shall categorize fire causes as human or non-human.

Stewart (1956) lists five non-human causes of wild fire in pre-settlement North America. Of these five factors, only two, lightning and volcanoes, are considered of great significance and volcanoes only

in the limited areas of their occurrence. Other causes sometimes suggested are tree branches rubbing together, spontaneous combustion in seams of coal and coal dust, and rocks falling on other rocks and making sparks. These latter causes are considered quantitatively quite insignificant.

Lightning is a potential cause of fire throughout North America. From 1935 to 1954 lightning was the cause of approximately 9 percent of all the Nation's fires. However, the importance of lightning varies regionally. In the Rocky Mountains lightning caused 70 percent of all of the fires in this same period, while only about 2 percent were lightning caused in the North Central states (Davis, 1959). Komarek (1964, 1967, 1968) has compiled considerable material on the incidence and characteristics of lightning-caused fires.

Numerous studies by historians, anthropologists, and ecologists have disclosed that the Indian had a significant influence on the fire regime of the North American wilderness. Fire was a tool of tremendous importance to early man. It is a logical supposition that the Indian spent much more thought and energy maintaining fire than putting it out (Stewart, 1956). There is some evidence that the Indian was quite reluctant to extinguish fires (Stewart, 1956; Lutz, 1959). This reluctance, often called "carelessness", may in

fact have been intentional. The problems of re-igniting a fire may have prompted the Indian to simply "bank" his fire in case he might pass by again and have further use for it. This procedure would have frequently resulted in a large-scale wildfire.

There is also considerable evidence that the American Indian deliberately started large-scale conflagrations. Several reasons for this behavior have been suggested. Hawes (1923) quotes a passage from an early New England writer who describes the forests of 1634 not as a dense wilderness but as "being cleare, so that one may ride a hunting in most places of the land...there is no underwood saving in swamps, and low grounds that are wet...." This open, brush-free character is attributed by the observer to periodic November woods fires set by Indians to improve hunting conditions. Indians apparently used fire for similar reasons in Yosemite Valley, California (Gibbons and Heady, 1964) and Alaska (Lutz, 1959).

A more direct use of fire for hunting purposes was described by Henry Schoolcraft (Williams, 1953). He observed Indians along the Mississippi River near Little Falls, Minnesota setting prairie fires to confuse and stampede bison herds. The animals injured in these stampedes could then be easily approached and

killed by arrows.

Fire was also used by Indians for signaling, to combat insects, and occasionally in warfare (Lutz, 1959). Fires set for any of these purposes could easily have become major conflagrations. Except in the immediate vicinity of their villages, the Indians would have had no particular reason for extinguishing such fires nor the ability to do so if they had wished.

For the purposes of this study, one cannot definitely determine what proportion of the fires in the Itasca area were Indian-caused or lightning-caused. Occasional dry lightning storms do occur in this portion of Minnesota and there are recorded incidences of lightning starting fires in the Park. However, the area was also inhabited by Indians who had fire-making capabilities. Within the concept that the Indian was a part of the natural wilderness ecosystem, it is perhaps not even critical that we know whether fires were Indian-caused or lightning-caused since we consider both to be "natural."

8.2 Incidence and extent of wildfires in Itasca State Park

In order to successfully evaluate the importance of fire in pre-settlement park environments information must be available on (1) the frequency with which

fires occurred in the area, (2) the location and areal extent of these fires, and (3) the influence each burn had on the biotic communities. The collection of these data occupied the greater portion of the field work in Itasca Park. The techniques used and the results obtained are discussed in the following pages.

8.21 Techniques

Several methods were used to determine the frequency and extent of fires in the pre-settlement forests of Itasca. Some information on historic fires can be found in the journals of the early explorers and fur traders. The primary source of information, however, is to be found in the forest itself. Fire scars on living trees provide evidence of past fires and make it possible to fairly accurately determine the year each fire occurred. Additional information on fire dates and extent can be derived from an analysis of the ages of even-aged stands which are of fire origin. Detailed discussion of each of these techniques is given below.

8.211 Historical references to fire

Information on the frequency and areal coverage of early forest fires is not readily obtainable from historic journals and reports. In many cases only

passing reference is made to a burn without details as to location or extent. In some cases, the existence of a burn can be deduced from secondary information. For example, Henry R. Schoolcraft noted that on his trip to Itasca in 1832 he passed through a stand of small, scrubby jack pine east of the east arm of Lake Itasca (Schoolcraft, 1834). This stand was also observed by J. Nicollet in 1836 (Nicollet, 1843). With our knowledge of the close relationship between jack pine and fire we can deduce that this area had been burned not too many years before. Similar deductions can be made from O. E. Garrison's observations (Figure 9) of a mixed jack pine-red pine stand south of DeSoto Lake, and from his notation that the area south of Elk Lake was covered by a young growth of birch and aspen with a few older jack pines and red pines "not killed by fires" (Garrison, 1881).

Several of the early visitors to Itasca made direct reference to burned areaa. On his 1872 map of Lake Itasca (Figure 7) Julian Chambers noted that the promontory between the east and west arms of the Lake showed "traces of forest fires" (Chambers, 1910).

The notes of the Government Land Survey of 1875 contain several references to burned areas. The two most extensive of these areas were east of the east arm and on the land between the two arms of Lake

Itasca (Figure 14).

O. E. Garrison paddled through the north arm of Lake Itasca in 1880 (Figure 9) and found that

> The western shore is badly burned, with but few pine trees standing, and the dense new growth of birches and aspens among the fallen trees makes it a very difficult tract to traverse.--Garrison, 1881

In his timber survey of 1899-1900, Brower describes many areas of the Park as seriously damaged by forest fires. His descriptions indicate that most of the northeast portion of the Park had been recently burned. The area immediately east of the east arm of Lake Itasca he describes as "burned barrens" (Brower, 1900). This area is depicted in Plates 1 and 2.

While none of these descriptions serve to precisely pinpoint the location or date of any one fire, they are of value when combined with fire scar and stand age data discussed below.

8.212 Dendrochronology as a tool in fire history studies.

The most comprehensive information regarding fire history was obtained by an analysis of the fire scars in the annual growth rings of surviving trees. This technique is an application of dendrochronology,

"the science which treats of the accurate dating of past events through the agency of trees" (Roughton, 1962). This dating of past events is accomplished by determining the ages of trees originating since the event or by counting annual rings back to some indicator or scar which identifies the event. An excellent history of the knowledge of tree rings can be found in Studhalter (1955).

Dendrochronological data have been used for dating such varied kinds of historic events as insect epidemics (Craighead, 1924); beaver dam construction (Lawrence, 1952); climatic fluctuations (Douglass, 1928); glacier history (Lawrence, 1950); severe frosts (Glock, 1951) and pre-historic human cultures (Douglass, 1942).

It has been recognized for some time that tree-ring analysis has considerable value in fire history studies. One of the earliest examples of this is Gardner's study of the occurrence and effect of forest fires in the Rocky Mountains of Colorado (Gardner, 1905).

Tree-ring counts can contribute two different types of information to fire history investigations. In "even-aged" stands of so-called "fire-type" species, ring counts are used to determine the age of the oldest trees in the stand. This stand age, subtracted

from the present date, can provide an estimate of the year when the stand originated. If one is reasonably sure the stand is of fire origin, the year of stand origin figure can be assumed to be a reasonably close estimate of the year a fire occurred in the area. Some correction may be required in this figure to account for delays in the regeneration process.

The noted ecologist Frederick E. Clements (1910) used stand age data to reconstruct the fire history of the lodgepole pine forests near Estes Park, Colorado. He was able to document fires which occurred in 1707, 1722, 1753, 1781, 1842, 1864, 1872, 1878, 1891, 1896, 1901, 1903, and 1905. Local tradition also verified the 1864, 1878, and 1901 fires. Clements was also able to find written historical documentation of the fires in 1903 and 1905.

There are many examples of the use of basal fire scar dates to develop fire chronologies. Fire sequences have been established in this manner for the southwest (Weaver, 1951), eastern Oregon (Keen, 1940; Weaver, 1943, 1959), southern Washington (Weaver, 1961), and the Sierra Nevada Mountains of California (Show and Kotok, 1924; Biswell, 1959; and Wagener, 1961).

The most extensive chronology was that constructed by Wagener. Using basal fire scars on several thousand incense cedar stumps, Wagener constructed

chronologies for six different locations in his study area. These chronologies began as early as 1540 A. D. and recorded as many as fifty-one fires at one location. Intervals between fires varied from seven to nine years (Wagener, 1961).

Fire scars result when a tree is exposed to heat which kills a portion of the cambium but is not sufficient to kill the entire tree (Plate 3). In succeeding years new wood grows over the dead area from the edges of the wound. However, the scar is still obvious when seen in cross-section.

Stand species composition and structure influence the effect of fire on the individual trees. Some dense stands are most susceptible to crown fires. This type of burn may almost completely destroy the stand, leaving little material for fire history study. Other species occur in more open stands which cannot sustain a crown fire. These stands are subject to periodic surface fires which affect the basal portions of the trees.

The thickness and quality of the bark is of considerable importance in determining the extent to which fire will damage a tree. Young trees with thin bark and species which characteristically have thin bark are so easily damaged that fire may cause complete girdling and death. Obviously, such tree species

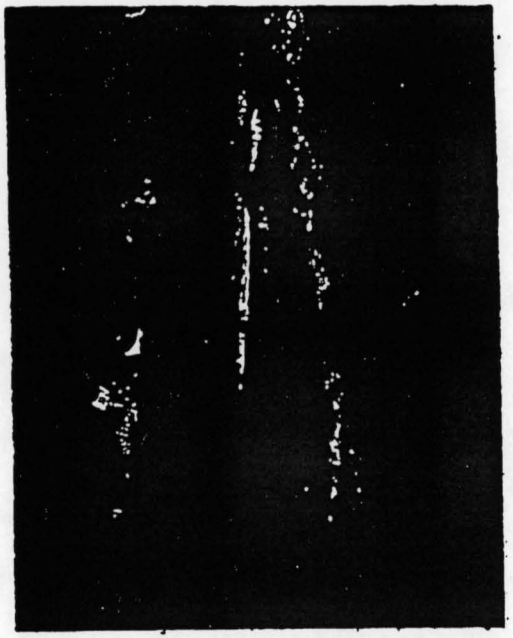

Plate 3. A 250-year old red pine showing the scars of at least five fires.

are not going to provide any extended record of fire occurrence. Other species of trees have very thick or otherwise heat resistant bark and are less susceptible to fire injury. These species more commonly sustain cambial injury on only a portion of the bole's circumference. They are thus able to survive repeated burns and provide a lasting record of fire occurrence.

All of these various factors influence the fire history studies in Itasca State Park. These forests are composed predominantly of red, white, and jack pine, white birch, aspen, white spruce, balsam fir, tamarack, and various northern hardwoods. The northern hardwoods, tamarack, and lowland spruce-fir types are generally too moist to carry anything but the most severe fires. The aspen and birch are very thin-barked species and are easily killed back to the ground surface by the first fire to occur in the stand. Jack pine stands may survive one or two surface fires but more typically are completely destroyed by crown fires. However, even in these cases, unburned trees or islands of trees frequently remain.

Red and white pines are quite resistant to fire injury. In addition, red and white pines generally grow in somewhat open stands and, as such, can carry only creeping surface fires. Each of these surface fires may leave its mark in the form of a fire scar.

However, white pine is extremely susceptible to rot after fire injury. This rot destroys the wood in the wound area and makes aging of the scar impossible. We are thus left with red pine as the one species most suitable for fire dating. It is on this basis that the bulk of the fire history data from Itasca have been derived from study of selected red pine trees.

Aerial photographs and vegetation maps were used to locate all pine stands within the Park. Each of these stands was then examined in the field. In every case the age of the stand or of each stand age class was determined. These figures allowed computation of the date of stand origin, which, in most cases, could be tied to a fire date.

During this field reconnaissance particular effort was made to locate the oldest fire-scarred red pine on the site. These trees provided the most complete record of fire occurrence.

The dates of the individual fire scars were determined by analysis of a select number of cross-sections and a considerable number of wood cores from increment borings. The counts from the stump cross-sections provided data for the construction of the basic fire chronology. More voluminous, but less accurate, data from the increment cores provided information on areal

extent of each burn and, in some cases, additional fire dates.

In the course of the field work cross-sections were obtained at fourteen locations and increment core data at sixty-eight (Figure 17). Additional data were obtained by examining old red pine stumps and dead snags. The charcoal coating on the fire wound surface and the concentration of pitch which occurs around the wound both serve to preserve the wood and prevent rot from destroying the fire scars (Plate 4). By determining the intervals between scars on a stump the dates can be fitted into the fire chronology of the Park. This technique proved extremely useful in the western portion of the Park where most of the older pines were cut in logging operations during the early part of the century.

There are several possible sources of error when using ring counts to date fire occurrence. Occasionally some annual rings will be missing and the count of years from the present to the date of the scar will be low. On other occasions extra or "false" rings may be present, resulting in a count of too many years. These two sources of error have received considerable study, particularly by dendrochronologists in the southwestern U. S.[1/]

1/ For a summary of pertinent papers, see Roughton, 1962.

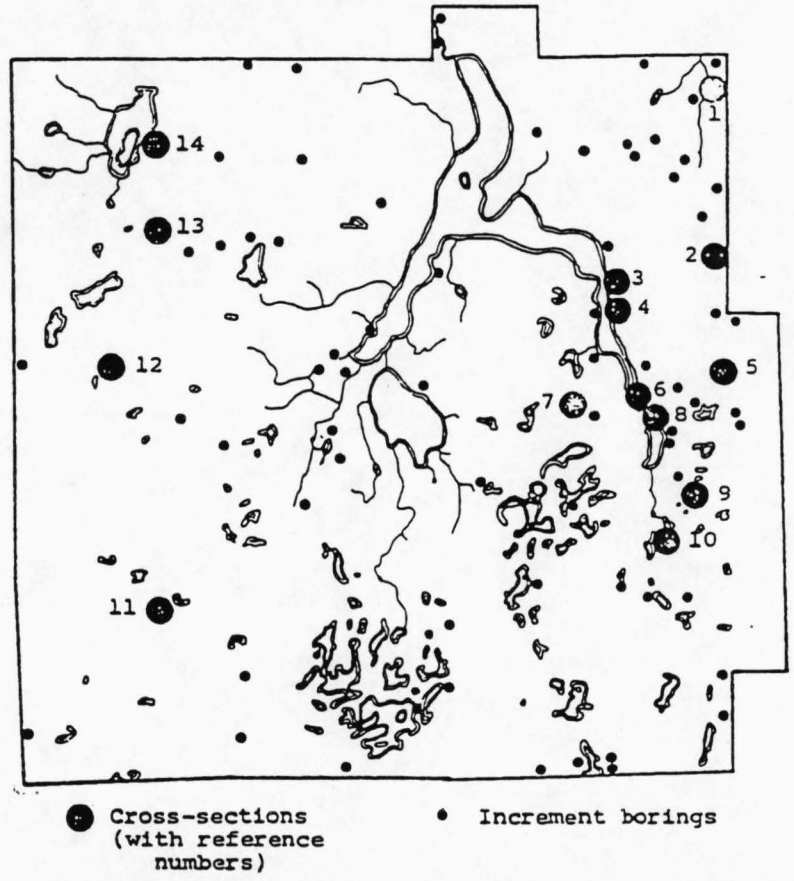

Figure 17. Locations of cross-section and increment core data collection sites in Itasca State Park.

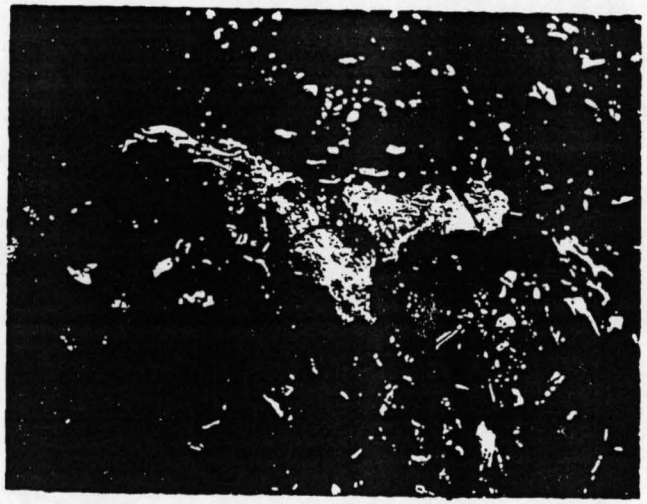

Plate 4. Stump of red pine logged in early 1900's. The scars of several fires are still visible and can be dated.

False rings and missing rings are error sources which can be expected in individual trees. In the current study all of the fire dates were repeatedly verified by counts in many different trees. Thus, it would seem that missing and false rings are not of great significance in the Itasca Park area.

The accuracy of the scar dating procedure is also influenced by the season of the year in which the fire occurred.. If the fire occurred in the fall of 1918 it would be impossible to determine from the scar if the fire occurred in the fall of 1918 after growth had ceased or in the spring of 1919, before growth began. Thus it is very possible that many of the dates in the chronology vary from the true date by plus or minus one year.

8.22 Fire chronology for Itasca State Park.

Table 1 contains a chronological listing of fires which occurred in Itasca Park between 1650 and 1922. This is a composite list of all fire scar dates discovered in the fire history studies carried out during the summers of 1964, 1965, and 1966. Although this is a complete list, its importance must be considered cautiously. All known fires are listed without regard to size. In some cases (e.g. 1871, 1838, 1742 and dates prior to 1712), the fire date recorded was

Table 1. Complete listing of all known fire dates and intervals between fires occurring between 1650 and 1922 in Itasca State Park.

Year of fire	Interval between fires	Year of fire	Interval between fires
1922		1843	
	4		5
1918		1838	
	5		18
1913		1820	
	2		9
1911		1811	
	2		8
1909		1803	
	2		7
1907		1796	
	2		9
1905		1787	
	6		15
1899		1772	
	4		13
1895		1759	
	4		17
1891		1742	
	2		15
1889		1727	
	2		15
1887		1712	
	2		10
1885		1702	
	10		32
1875		1670	
	4		9
1871		1661	
	7		11
1864		1650	
	21		

verified at only one location as a scar on a single tree. These dates are obviously not as significant to the ecology of the Park as is 1864, the date of a fire recorded at all sampling sites in the area.

An additional concern is that scars identified on only one tree may date a small lightning fire, a human campfire built at the base of the tree, or some form of cambial damage not related to fire at all (porcupine gnawing, for example).

Table 2 presents the data in a more meaningful form. Scar dates which were recorded at only one location have been eliminated, as have all fires occurring during the logging and land clearing period following 1900. In addition, the chronology has been stratified by Park "zones". These zones (Figure 18) were established in a partially arbitrary and partially empirical manner. The boundary between northern and southern portions of the Park were arbitrarily located simply to divide the Park for discussion purposes. The remainder of the boundaries follow such natural fire breaks as lake shores, streams, and lowland areas which could keep a fire inside or outside of a particular zone.

Data on the number of fires per zone and the average, maximum and minimum time interval between

Table 2. Listing, by zones, of the major fires and intervals between fires in Itasca State Park between 1712 and 1900, as verified by basal scars.

Northwest		Southwest		Southeast		Northeast		Central	
Year	Int.	Year	Int.	Year	Int.	Year	Int.	Year	Int.
				1899		1899			
					4		4		
				1895		1895			
					4		4		
		1891		1891		1891			
			2		2		2		
		1889		1889		1889			
			4		4		4		
1885		1885		1885		1885		1885	
	10				10		10		10
1875				1875		1875		1875	
			21		4				
	11			1871			11		11
					7				
1864		1864		1864		1864		1864	
	26								
1838			44		44		44		
	18								53
1820		1820		1820		1820			
	9		9		9		9		
1811		1811		1811		1811		1811	
	8		8		8		8		8
1803		1803		1803		1803		1803	
	7				7				
1796			31	1796			31		31
	24				24				
1772		1772		1772		1772		1772	
	13		13		13				13
1759		1759		1759			45	1759	
					17				
	32			1742					32
			47						
1727					30	1727		1727	
	15						15		
1712		1712		1712		1712			

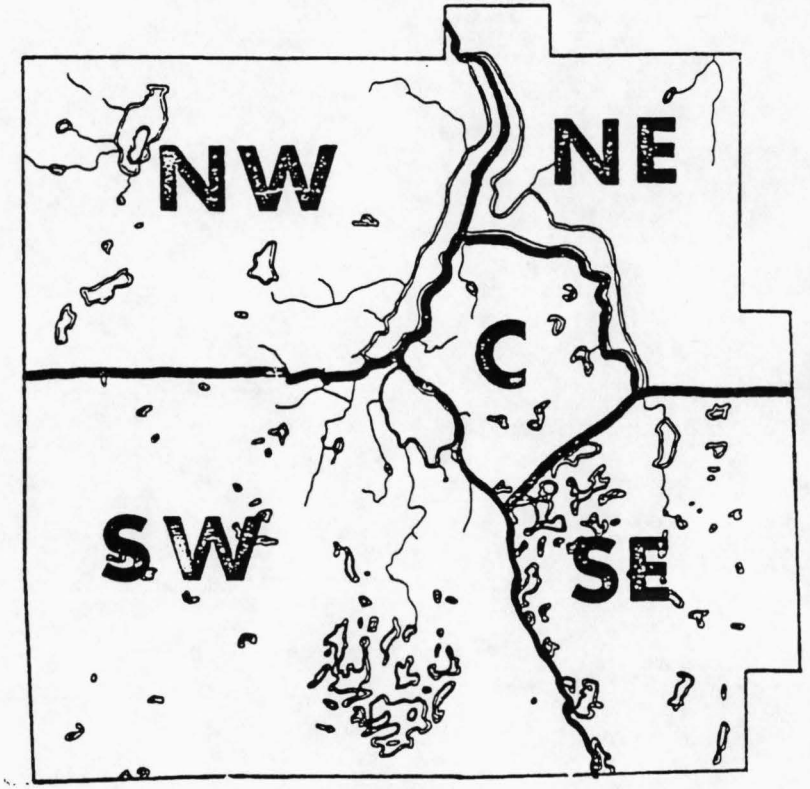

Figure 18. Zones used in discussion of fire history data from Itasca State Park.

fires are presented in Table 3 for the period 1712 through 1900.

The various zones are rather uniform in fire occurrence and frequency with the possible exception of the central zone. It is immediately evident that fire seems to have occurred less frequently in this zone than the others. This is implied by the lower number of fires, these having occurred at a greater average, maximum, and minimum time interval. The explanation for this seeming fire resistance may lie in the well-protected nature of the zone. Lake Itasca on the west, north, and east, and Elk Lake to the southwest, provide firebreaks for the central zone. Also, the small sample for the zone may confound the data.

The average interval between fires for all zones combined is 16.3 years. This average appears low when compared to the high maximum intervals of from 32 to 53 years. The median value of 10 years seems even more peculiar. Actually, inspection of Table 2 will show that most of the fires (some 68 percent) occurred at intervals of from two to sixteen years. This observation immediately attracts attention to the relatively few long fire-free intervals in the data. 1/

1/ Although called "fire-free" periods, a more correct term is periods free from major fires. Several small, inconsequential burns occurred during these periods.

Table 3. Number of fires, and the average, maximum, minimum time interval between fires, summarized by zones for the period 1712 to 1900.

	ZONE				
	NW	SW	SE	NE	C
Number of fires	12	10	16	13	8
Ave. interval (yrs.)	16	20	12	16	23
Max. interval (yrs.)	32	47	44	45	53
Min. interval (yrs.)	7	2	2	2	8

When summarized and ordered as in Table 4, these large gaps in the fire record can be tied to a few specific periods of time. These periods are the years following the fires of 1712, 1727, 1772, and the group of fires which occurred in 1803, 1811, and 1820.

This apparent relationship between long, fire-free time periods and certain fire years can be explained in several ways. The most likely explanation is that these long intervals follow the occurrence of severe and widespread fires in the Park. These fires reduced the fuel accumulation and changed the micro-climate at the ground surface sufficiently that the landscape (within the particular zone affected) was essentially fire-proofed for 30 to 50 years. The fire area maps presented in the Appendix and discussed later in this chapter, provide verification of the assumption that widespread burns occurred in 1712, 1727, 1772, and 1803-1811-1820.

Another possible explanation is that these fire-free intervals mark periods during which climatic conditions were unfavorable to the start or spread of fire. This condition of poor fire weather would obviously prevail over all of the Park during any one period. Figure 19 depicts graphically the pattern of

Table 4. The relationship between certain major fires in Itasca State Park and subsequent fire-free intervals.

Date of Burn	Interval until next burn		Average interval before next burn (all zones) (Years)
	Zone	Interval (Years)	
1803-1811-1820	NW	44	46
	SW	44	
	SE	44	
	NE	44	
	Central	53	
1772	NW	24	28
	SW	31	
	SE	24	
	NE	31	
	Central	31	
1727	NW	32	36
	NE	45	
	Central	32	
1712	SW	47	38
	SE	30	

Figure 19. Pattern of fire-free periods in Itasca State Park, Minnesota
(Dates are years of fire occurrence)

Zone			
NW	1727..............1759	1772.....1796	1803-11-20....1864
SW	1712....................1759	1772...............	.1803-11-20....1864
SE	1712..............1742	1772.....1796	1803-11-20....1864
NE	1727......................	..1772...............	.1803-11-20....1864
Central	1727..............1759	1772...............	.1803-11........1864

these fire-free periods. We can see that for the <u>entire</u> Park there really is no fire-free period except for 1820 to 1864. During that time only two small burns occurred in 1838 (northwest and southeast zones) and 1843 (southwest zone). Perhaps this relatively fire-free period is a result of climatic conditions. However, it appears most likely that fuel reduction accounts for the other long intervals.

8.23 Areal extent of fires in Itasca State Park.

The many observations of fire-scarred trees scattered over Itasca Park have made it possible to construct a series of maps showing the boundaries of each individual fire. This series of maps is presented in the Appendix.

Because of the extensive area involved, and the large number of fires to be studied, the fire area maps depict only approximate fire boundaries. In order to locate the boundaries of a fire, all sample trees old enough to have been alive at the time of the particular fire were plotted on a map of the Park. Then, all those sample trees which actually showed a scar from this fire were so designated. In this manner, areas burned and not burned were identified. Additional information was obtained by plotting the locations of pine stands which originated from the

fire being mapped. The fire boundaries were then sketched in free-hand between these various sample points. The boundaries were drawn roughly mid-way between adjacent points of occurrence (scarred trees) and non-occurrence (trees not scarred) unless some obvious fire barrier existed which could be expected to have influenced the location of the fire boundaries.

The accuracy of a fire area map is directly dependent upon the amount of data available. It should be noted that for several fires, evidence of occurrence is shown on the map but boundaries have not been drawn. Some of these fires (1922, 1909, 1887, 1871, 1843, 1838, and 1787) were very small in acreage. Their boundaries might be reconstructed by intensive, time-consuming examination of many fire-scarred trees in the vicinity. There was not sufficient time during this study to do such detailed analyses.

In other instances, only a few scar locations are plotted because only a few trees were found which were old enough to have survived the particular fire. This situation is true for the fires of 1702, 1670. 1661, and 1650. Only five trees originating before 1702 were found. Four of these were scarred by the 1702 burn, but they are widely scattered. It is quite impossible to realistically indicate a fire boundary.

This problem is even more acute for the 1670 burn with only two sample locations, and impossible for 1661 and 1650, with only one sample observation. However, these last three dates are significant in that they push the evidence of fire occurrence back an additional fifty years. The scars of these burns were found on a 348-year old red pine in the southwest ¼ of the northeast ¼ of Section 30, T. 143 N., R. 35 W. This was the oldest red pine located in the park (Cross-section No. 9 in Figure 17).

Some interesting observations can be made about the patterns of the various fires. The burns in 1922, 1917, 1909, 1907, and 1905 were all confined to the edges of the park. These, quite likely, were fires which burned into the park from logging and land clearing operations in surrounding areas, since they all occurred during the period when these operations were at a high level.

The amount of the park covered by any one burn is quite variable. Extensive burning throughout the entire park occurred in 1885, 1864, 1820, 1811, 1803, 1772, and 1759. These were mentioned earlier as severe fires which were each followed by long fire-free periods.

It is quite obvious from the maps that the area between the east and west arms of Lake Itasca was indeed effectively protected by natural fire breaks. This area was apparently burned over only by the very severe fires

of 1864, 1803, 1772, 1759 and, perhaps, 1727.

8.3 The influence of wildfires on the biotic communities of Itasca State Park.

Data from Itasca Park and from many other parts of North America indicate that fires occurred very commonly in pre-whiteman natural environments. One would expect that such a widespread and frequently occurring ecologic factor would play a significant role in molding the character of the biotic communities. There is increasing evidence that this indeed has been the case.

The most obvious and direct influence of fire is its effects on the composition and age structure of the vegetation. Fire also has direct influence on the survival of the animal component of the biota. Some individual animals are certainly killed by a fire or driven from the area of the burn. However, the most significant effect of fire on wildlife is an indirect one. Essentially all animals depend on vegetation for food, protection, and homesites. The individual wildlife species have each adapted to a certain set of vegetational conditions. These conditions are various combinations of plant species, age classes, and distribution patterns. Fire indirectly influences the composition and size of animal populations by directly modifying the vegetation on which they depend.

8.31 Vegetational patterns resulting from fires in Itasca State Park.

Early in this paper, the assumption was made that fire has played an important part in the ecology of red, white and jack pine. This assumption was based on considerable past ecological research on these species and their fire relationships. Much of this research has been summarized by Ahlgren and Ahlgren (1960).

In the investigations in Itasca Park an effort was made to verify the relationship between fire incidence and the occurrence of pine stands. Most of the major pine stands were visited and data collected on the age of the stand or of the various stand components (many stands were made up of several age classes). In nearly every case, the date of origin of the stand or stand component corresponded closely with the year in which a burn had occurred on the site.

The burn area maps contained in the Appendix also show the major pine stands (jack and red pine) which appear to have been established as a result of each fire. It is apparent from these maps that not all of the recorded fires resulted in the establishment of significant acreages of pine. Considerable

acreage of pine type originated following the fires of 1712, 1772, 1803, 1811, and 1820. These age classes make up the bulk of the existing old growth red pine in the park. Other burns, particularly in the northeastern zone, regenerated sizeable stands of mixed jack and red pine. Such stands date from 1885, 1889, 1891, 1895, and 1899.

Several fires which burned widely over the park failed to produce any great amount of pine which survives today. The fire of 1864 was one of the most extensive burns recorded, yet very little evidence was found of an age class of pine dating from 1864. Similar circumstances hold for the large fires of 1759, 1875, and 1885.

The successful regeneration of a stand is contingent upon the satisfaction of several environmental and biotic criteria. The fire must be intense enough to destroy the litter and humus and expose the requisite mineral soil seed bed. It may also be important that the fire remove a shrub layer or reduce the density of an overstory which might compete with the new seedlings.

Recent studies by Buckman (1964a, 1964b) and Buckman and Blankenship (1965) indicate that season and frequency of burns are also critical factors. Repeated spring burns killed aerial parts of aspen and hazel, but induced vigorous sprouting. Aspen eventually was reduced

in vigor and number of stems, but hazel continued to resprout. Hazel cover was significantly reduced, however, following repeated summer burns. Warm summer days dried the humus layer and allowed fire to burn down into the hazel roots. In addition, the aerial stems were killed at a time when food reserves were low, thus inhibiting regrowth.

Frequency of burning is also of importance after pine seedlings have established, for if fire occurs too frequently, the young seedlings may be killed.

A fire of too great an intensity can reduce the chances of successful regeneration by destroying the seed crop. Jack pine has fire-resistant cones which will protect the seed from all but the most intense flames. This situation is of greater concern for red and white pine.

If the surviving trees on the burn or adjacent to it fail to have a good seed crop for several years following a fire, dense shrub and herbaceous cover may develop, precluding future pine regeneration. Climatic conditions in post-fire years are also critical.

The failure of pine species to regenerate following the fires of 1759, 1864, 1875, and 1885 could be the result of a failure of any one or combination of the criteria discussed above. There is no way at

this time to identify the causal factors.

The fire area maps with stands of fire origin indicated aid us in understanding the importance of fire in the development of vegetation patterns. In areas where a pine seed source was available, fire frequently resulted in pine reproduction. Each successive fire resulted in a new or additional pine age class.

If an area was reburned several times at frequent intervals, the pine reproduction would have been destroyed and aspen, birch, or upland brush species would take over, In some areas, fires occurred so infrequently as to allow successional development (on suitable soil types) to northern hardwoods or white spruce—balsam fir types. Such conditions apparently prevailed between the east and west arms of Lake Itasca, on the east shore of the Lake near Bearpaw Point, and at several other locations in the Park.

The combination of irregular burn areas and frequencies, differing seed sources, varying reproductive success, and soil textural differences resulted in a complexity of vegetational patterns. The pre-settlement park area was a patchwork of forest stands of different sizes, species composition, and age structure. Such a patchwork appearance is still visible

on the 1967 vegetation cover map (Meyer, 1967).

8.32 The effects of fire on wildlife

All evidence from this study indicates that wildfire has played a significant role in determining the composition, age structure, and type patterns of the vegetation of Itasca State Park. This leads us to the relatively safe assumption that the composition and distribution of wildlife species in the Park have thus, in turn, been influenced by wildfire.

In a paper on the fire-wildlife relationship in Canada, Cringan (1958) stated that

> The main long-term indirect effect of fire is in the /plant/ succession it causes. In the absence of other succession-initiating factors, fire creates habitat for wildlife of the early and middle successional stages, at the same time destroying or adversely affecting the habitat of climax species.

The pre-settlement vegetation of Itasca Park, as described in earlier chapters, was composed of a patchwork pattern of age and species groupings. Large portions of the park were in early and middle successional stages much of the time. Consequently, following Cringan's theory, we would expect the animals in the park to have been those species adapted to such habitats.

The only positive evidence we have of the composition of pre-settlement wildlife communities in the park is that derived from historic journals and reports. From this evidence, discussed in detail in Chapter 7, we can infer that the following species were present:

Herbivores	Carnivores
white-tail deer	black bear (actually omnivorous)
elk	wolf
moose	coyote
beaver	fox
muskrat	wolverine
cottontail rabbit	bobcat
snowshoe hare	cougar
gray squirrel	striped skunk
flying squirrel	fisher
red squirrel	pine marten
	otter
	weasel (several species)
	mink

Information on the life histories and food habits of these species indicates that in most cases they are found either exclusively or in greatest abundance in seral plant communities.

The elk or wapiti feeds primarily on grasses, shrubs, and trees such as aspen and birch. This type of vegetation is found in great profusion on recently burned areas. As a result, a close relationship can be shown between recent burns and elk population concentrations (Pengelly, 1960). As post-fire succession takes place, this profusion of grass, shrubs, and herbs

gradually gives way to forest stands of increasing density. This change results in decreasing range carrying capacity.

Cringan (1958) estimates that in Canada, the carrying capacity of moose range approximates four moose per square mile on recently burned areas. Sixteen to thirty years following the burn the carrying capacity is reduced to about two moose per square mile, and after 46 years, to four square miles per moose. Hosley (1949) states that "climax forests below timber line offer practically no food for moose in Alaska. Fire results in sub-climax vegetation and makes the presence of moose possible." Studies by Aldous and Krefting (1946) of moose range on Isle Royale in Michigan support this relationship.

Cringan (1958) suspects a larger and more rapid decline in carrying capacity of deer as plant succession takes place. Studies of white-tail deer food habits indicate a preference for shrub species and tree browse species found in greatest profusion on recently burned areas (Taylor, 1956).

Grange (1965) notes that although the snowshoe hare (Lepus americanus) inhabits nearly all stages of the northern forest, the species attains its greatest abundance in "very early succession forest stages not long after the occurrence of fire."

In a study of two forested drainages in Colorado with markedly different beaver populations, Rutherford (1955) found that beaver populations were confined to areas of second-growth burn forest containing aspen-lodgepole pine mixtures. Beaver were seldom found where fire had not occurred and old growth timber stands prevailed. Longley and Moyle (1963) report that in Minnesota, aspen, the preferred beaver food, may grow too large to be easily available unless periodically disturbed by "beavers, fire, or lumbering."

Bird populations are also influenced by the age and composition of the forest vegetation. The relationships between birds and various northern forest communities in Ontario were reported by Martin (1960). He found that more diversified vegetation, such as that in an area subject to frequent, periodic burns, contained more habitat niches and consequently could support more species of birds.

Vegetation, through its influence on the species composition of the herbivore population, indirectly affects the make-up of the carnivorous predator population. Moose, elk, and deer are primary prey species for wolves and cougar (Stenlund, 1955; Mech, 1966; Young and Goldman, 1946). These carnivores could survive in a climax forest by feeding on

squirrels, mice, and those few big game animals found there. However, one would expect the greatest populations of carnivores to occur in the early plant succession stages which support large herbivore populations.

The black bear is considered an omnivore. It feeds primarily on berries, nuts, pine seeds, insects, fish, and small mammals (Martin, Zim and Nelson, 1951). Occasionally, a black bear will kill a deer and he frequently eats carrion. Such staple food plants as blueberry, raspberry, serviceberry and wild cherry are in greatest abundance on recently burned areas. Numbers of rabbits, ground squirrels, and mice might also be expected to be greater in such areas. This would also influence wolverine and bobcat numbers, since both of these animals depend heavily on such prey species.

PART IV

THE IMPLICATIONS OF PROTECTION-PRESERVATION POLICIES

The early chapters of this paper contain a discussion of the evolution of park and wilderness management philosophy. This review pointed out the gradual shift from a protection policy to an increasing recognition of the frequent need for active management programs to insure the preservation of certain biotic communities and ecological relationships.

The Itasca State Park example presented in Part III provides an excellent case history of an area managed under the protection-preservation philosophy. The nature of the pre-settlement communities and the history of fire in the park have been described in detail.

We turn to the Itasca Park case again in Chapter 9 to discuss the results of applying the protection-preservation policies to areas established to preserve sub-climax biotic communities. Active management, an alternative policy, will also be discussed.

CHAPTER 9

THE EFFECTS OF PASSIVE PROTECTION POLICIES AND POSSIBLE MANAGEMENT ALTERNATIVES IN ITASCA PARK

The development of a management program for any park area depends first on the formulation of a management goal. In the selection of this goal, consideration must be given to (1) the legal mandates which apply to the area and (2) the values which are of importance to society and to the park visitor.

The act which provided for the establishment of Itasca State Park in 1891 refers to the objective of the park only in a general manner. From the great emphasis placed on acquiring the old growth forests before they could be logged, it is obvious that preservation of this forest was uppermost in the minds of the founding fathers. That this was indeed the management goal is further spelled out in Chapter 90 of the General Laws of the State of Minnesota, 1907. This law provides that "the State Forestry Board shall preserve intact the primeval pine forest now growing in Itasca State Park...."

Although this original objective of maintaining primeval pine forest was established in the 1890's, recent research indicates that this goal is still pertinent and, in fact, agrees closely with the value

systems of todays park visitors (Klukas and Duncan, 1966). Thus, the management goal most apropos to Itasca State Park is the preservation of the forests of the area as they existed when the park was established in 1891, with particular emphasis on the maintenance of the old-growth pine.

The management policy adopted to attain this goal has closely resembled the national park and wilderness philosophy of no interference with nature, which prevailed before the appearance of the "Leopold Report". Strict fire control has been in effect since the park was established and has been almost completely successful since 1920.

At this point in our analysis of the management of Itasca State Park, it is appropriate to assess how successful the protection-preservation policy has been in insuring the preservation of the pre-settlement biotic communities for which the park was established.

9.1 The effects of modern man on the park ecology.

Although most of our large parks and wilderness areas appear to be quite natural, they have, almost without exception, been influenced to some extent by modern man.

9.11 Pre-establishment influences

Most of our parks and wilderness areas were established in regions which had already been explored

by modern man. In many cases, human settlement had already occurred. Extreme examples of this are to be found in Great Smoky and Shenandoah National Parks, where many mountain families had to be relocated outside the new park boundaries (Tilden, 1968).

European man arrived in the Itasca area in the early 1700's. French fur traders were traveling through at this time from fur posts farther down the Mississippi. A Northwest Company post was located on Lake Bemidji in 1784 (Hagg, 1942). Trappers from this post certainly visited Itasca.

By 1875, settlements were in existence at Detroit Lakes (southwest) and Wadena (south). The first settler within the present boundary of the park arrived in 1883 (Brower, 1893). In the following few years several other individuals established homesteads for short periods. Several of these settlers cleared off the forest to provide space for farms. Hunting and fur trapping were important means of providing food and income.

By 1890, lumbering operations in northern Minnesota were approaching the Itasca area. Some portions of the present-day park were actually logged before they were acquired for park use.

All of the human activities described above in-

evitably altered the biotic community relationships. Hunting and trapping pressures were sufficiently heavy to extirpate the wolf, moose, elk, fisher, wolverine, and beaver. Other species were severely reduced in numbers. Plant communities were also affected. Logging operations and the subsequent removal of merchantable materials certainly cannot be considered a natural phenomenon. Logging and agricultural land clearing were activities which were characteristically accompanied by fire. Although it has been demonstrated that fire was a natural ecological factor in this area, the activities of modern man resulted in fires at unnatural intervals and of a different character than natural fires.

Table 5 illustrates that during the period of early settlement (1850-1899) fires occurred with a frequency almost twice that of pre-settlement years. This average interval became even shorter during the land clearing, logging period of 1900 to 1922.1/ These more frequent fires could have considerable influence on the vegetation. If the period between successive fires is too short, the reproduction which occurs following one fire may not be old enough to

1/ There is also the possibility that this increased fire frequency may have been related to warming and drying of the climate since the cold wet period of the "Little Ice Age."

Table 5. Average time intervals between fires in Itasca State Park.

Time Period	Average Interval (Years)
1650-1699	16.7
1700-1749	12.5
1750-1799	12.5
1800-1849	10.0
1850-1899	5.6
1900-1922	3.1

survive the second. Thus, the amount of successful pine regeneration could be reduced. This suppression of tree reproduction could result in increased acreages of upland brush.

9.12 Park size influences

The plant and animal communities of Itasca State Park were once a part of a larger, continuous biota of northwestern Minnesota. The establishment of the park boundaries resulted in artificial and arbitrary divisions within biotic communities. As a result of the development of modern civilization, great differences in environmental conditions now prevail on each side of the park's boundaries. This problem is present in most of the Nation's parks and wilderness areas.

Before settlement, wildlife populations were free to migrate as necessary. Now, in many areas, land uses outside the park boundary interfere with such mass movements (or vice versa). Such is the case with the elk population problems in Yellowstone National Park. In many areas, the critical lowland winter ranges are outside the park and are now fenced-in farms and ranches.

Predator populations are seriously affected by boundary locations. Wolves, bobcats, cougars, and

bears are fine members of the park community but are in danger of losing their lives if they cross the boundary onto livestock ranges. Wolves, bears, and cougars have extensive home ranges which can be completely contained only within the largest of parks. In smaller areas such as Itasca State Park, these species were extirpated by poisoning, trapping, and hunting programs outside the park. In many cases, livestock interests were sufficiently strong to force enactment of predator control policies within the early parks.

To this list of "extra-park" environmental influences, we could add air and water pollution of the park from outside sources. In addition to pollution, we have artificial changes in the quantity of water supplied. Such a problem is seriously endangering the biotic communities of Everglades National Park, where impoundments for flood control and agricultural uses have reduced the amount of water entering the Park.

Many areas dedicated to the preservation of natural communities have been impaired by the invasion of exotic species introduced on lands outside the reserved area. These exotic species include mammals, birds, insects, and disease pathogens. A pertinent example in Itasca Park is the presence of white pine

blister rust, an introduced disease which has seriously affected the eastern white pine.

This discussion serves to illustrate that most of our parks are not self-contained ecological units. Consequently, the objective of natural community preservation is continuously being subverted by outside pressures.

9.13 Recreational use influences

Outdoor recreation is a permissible activity in all parks and wilderness reserves, with the exception of strict scientific natural areas. This land use, and the developments which it soon stimulates, can have significant effect on natural communities.

Recreational developments such as buildings, parking lots, roads, and large auto campgrounds completely change the ecology of their immediate site by requiring removal of the vegetation and coverage of the surface with wood, concrete, or asphalt. Such supporting facilities as power transmission lines, sewer and water lines, and sewage lagoons each take their toll on the natural ecosystem.

Large numbers of people visiting park and wilderness areas have additional impact beyond the immediate developed sites. Such mass human activity crushes vegetation, compacts soils, and disrupts wildlife

populations. Species such as bears may suffer direct purposeful reduction if they interact too closely with recreation visitors.

9.14 Management influences

The management activities instituted by park and wilderness administrators to "preserve" the natural biotic communities must, in all too many cases, be listed as factors detrimental to these same communities.

Predator control was an accepted policy in the early days of many of our parks. It was thought necessary to control wolves, cougar, and coyotes in order to protect such species as deer and elk. The philosophical (not to mention ecological) impropriety of this policy was soon recognized, but not before many important carnivorous members of some ecosystems were extirpated.

At the same time, the policy of carefully protecting deer and elk from predators and hunting soon backfired. The result has been population buildups which soon outstripped the range carrying capacity. The solution to this wildlife problem in the national parks is still being sought.

In Itasca State Park predator control and game protection policies combined to produce an over-

abundance of starving deer. This situation has been artificially alleviated by periodically opening the park to hunting.

Perhaps foremost in the list of adverse management influences is the unforeseen ecologic implications of combining a preservation goal with a management policy of complete fire protection. Again, this problem is pertinent to most parks and wilderness reserves. Itasca State Park offers an excellent case in point.

The natural, periodic occurrence of wildfire in the pre-settlement Itasca Park area has been documented in Chapter 8. However, upon official establishment of Itasca as a state park, one of the first management programs adopted was absolute control of all fires. This protection has been extremely successful. With the exception of a few early fires which probably entered the park from logging operations outside (1905, 1911, 1917), no fires of any consequence have occurred since 1900.

Park management programs which have included a policy of complete fire control have also had considerable influence on the success of efforts to preserve natural biotic communities. The implications of such a policy are of great importance in Itasca Park and

in many other park areas. These implications are discussed in detail in the next section with particular emphasis on Itasca Park.

9.2 Effects of fire control in Itasca State Park

The pre-settlement biotic communities of Itasca Park have been shown to be predominantly sub-climax and dependant upon periodic disturbances by fire (Chapters 7 and 8). While attempting to preserve these biotic communities by protecting them, man has actually interfered with natural processes. This interference has resulted in serious deviation from natural conditions. Detailed studies of the influence of current management practices are underway. However, we can discuss the more obvious results in a general way.

9.21 Changes in fire occurrence

The fire chronology developed in this study indicates that prior to 1850 a fire occurred in Itasca Park on an average of every 12.9 years. This average interval decreased during the next 50 years probably as a result of the increasing incidence of man-caused fires as civilization moved closer to the Park and simultaneous general drying and warming of the climate.

Itasca State Park was officially established in

1891. Fire control was an immediate concern of the Park Commissioner, but full protection was not immediately attained. In spite of all efforts, fires of considerable size occurred in 1895, 1899, 1905, 1911, 1913, and 1917, all within the official park boundary as established at that time.

By 1920 considerable progress had been made in fire protection programs. This progress is evidenced in Itasca Park by a drastic decrease in fire incidence. Records of the District Forester at Itasca Park indicate that between 1938 and 1963 only ten fires occurred. Two of these fires were lightning-caused and the rest man-caused. Quick action was taken to control each of these fires. Seven fires were contained within ¼-acre and the largest burned only five acres. 1/

This drastic reduction in fire occurrence is attributable to several factors. Indians apparently had been a major cause of fires and by this time Indians no longer freely roamed this area. Agricultural land uses in the prairie areas to the south and west perhaps reduced the incidence of priaire fires which would move eastward and enter the park. Also, forest removal and land clearing had surrounded the

1/ Summarized by Park Naturalist Ben Thoma and printed in "Itasca Notes", 1966.

park with a relatively fireproof zone. By 1920 the period of major land clearing and lumbering operations was passed and the fires resulting from these activities consequently diminished. This was also a time of increasing public awareness of the need for fire protection on managed forest and agricultural lands.

9.22 Influence of fire protection on vegetation.

Such highly successful fire protection as attained in Itasca State Park could only result in considerable change in the character of a predominantly subclimax vegetation. The changes which appear to have occurred are in evidence in many similar parks across the Nation.

All of the pine species occurring in Itasca Park are more or less dependent on fire to produce suitable conditions for reproduction (Ahlgren and Ahlgren, 1960). Without periodic burns the necessary combination of mineral seed beds, reduced shrub competition, and thinned overstory have not been attained. As a consequence, there has been a marked decrease in pine regeneration. With a few exceptions, seedlings are to be found in quantity only in road cuts and gravel pits.

The nature of current pine regeneration patterns is the object of a study now underway in the park.

Preliminary results from this investigation indicates a decided lack of pines in the early age classes and an increased abundance of brush.

Currently in Itasca Park we have a pine forest of primarily older age classes in which considerable mortality is occurring with little or no establishment of younger stands for replacement.

Hansen and Duncan (1954) reported that of 6,585 acres of red and white pine in Itasca Park, some 3,276 acres were to be considered "over-mature" (200 years or older). Most of the remaining pine acreage was in stands over 100 years of age.

The fire maps contained in the Appendix illustrate the locations of stands originating from fires of various dates. Most of the pine stands were established following fires in 1712, 1727, 1772, 1803, 1811 and 1820. These stands now (1969) are from 149 to 257 years old. Trees of age 200 and over are extremely susceptible to wind throw, breakage, and insect damage. Many of these trees are blown down each year.

From all indications, much of the forest in Itasca Park is evolving into stands of aspen, birch, northern hardwoods, or balsam fir. The sub-climax types such as red, white, and jack pine are slowly but surely passing out of the picture. Much of the

evidence available indicates that this shift is attributable to the fire protection policy of the past 60 years.

9.23 Effects of fire control on wildlife populations.

If the current successional trend toward climax forest types is indeed the result of fire protection policies, then we can evaluate the effect of fire control on the park fauna by examining the influence of the changing forest types on the various wildlife species.

We have determined in Chapters 7 and 8 that the pre-settlement biotic communities (which we have labeled as "natural") occurred in a patch-work pattern of many age classes and structural combinations. We attributed this ecologic variety to frequent periodic disturbances by fire which continually re-initiated new secondary developmental sequences. This variety of vegetative types and age classes, and the many ecotonal areas which result, provide habitat for an equally varied collection of mammals and birds.

One likely result of successional development to climax hardwood or spruce-fir types is a reduction in vegetational variety. This development involves moving from even-aged types spread over the park in small groups (individual burns) to all-aged types

spread over extensive areas. Diminished variety in plant communities would result in a reduction in the availability of ecological niches and a consequent reduction in wildlife species diversity. Animals and birds which thrive in successionally early vegetation stages (such as recently burned areas) would find much less suitable habitat in a climax forest.

9.3 Active management: an alternative preservation policy

Early in this paper, considerable emphasis was placed on the need to select a management goal before developing a park management plan. We reviewed the evolution of national park, wilderness and state park philosophies and arrived at the decision that, in most cases, the goal of management was to preserve the ecological relationships which existed prior to disturbance by modern man. Our study of the ecological situation in Itasca State Park indicates that the management program in effect is not preserving the natural ecological relationships and biotic communities.

If we assume that no change in the original management goal of the park is warranted, then it is apparent that some changes in the management program are in order.

It seems logical that a new program might adopt the "active" management philosophy of biotic community maintenance and restoration as proposed by the Leopold Committee (Leopold, et al., 1963). Obviously, such a radical departure from existing protection policies could not be made without considerable background research.

9.31 Information required to evaluate an active management program.

The Leopold Committee recommended that active management programs be developed in four steps (Leopold, et al., 1963). The first step suggested was "historical research" to determine as accurately as possible what biotic communities and relationships existed in pre-settlement times. This type of research is described for the Itasca Park area in Chapter 7 of this paper. Historic documents, land survey notes, and field studies were utilized to determine exactly what sort of biotic associations we should be concerned with restoring and maintaining.

The second step in implementing an active management program is to evaluate the ecological situation in order to fully understand the workings of these biotic associations. This work has been partially completed in the Itasca area. Chapter 8 discusses the

importance of fire in the dynamics of pre-settlement biotic communities. The implications of fire protection are evaluated in Chapter 9. However, additional research is necessary to determine the ecological status of currently existing communities. What biotic associations now exist after some 50 years of protection? How much do these contemporary communities differ from those of pre-settlement times? What environmental factors now act to control these communities? What successional trends are evident?

Some of these questions are currently being examined in Itasca Park. Additional studies may be required before active manipulation of the biota can be attempted with assurance of success.

Step three of the Leopold Committee's suggested schedule calls for small-scale test applications of prescribed burning, cutting, herbicides, or whatever management tools are selected to simulate natural ecological disturbance. Also at this time efforts should be made to explain the management program to concerned public groups.

This activity is also currently underway in Itasca. Study areas have been located in pine and aspen stands. Randomly selected plots will be treated by various manipulation techniques in order to

evaluate their ecological impact. Considerable effort is being made in the park interpretive program to explain the importance of fire in the natural ecosystem.

The fourth and final stage is full-scale application of the selected management procedures. This stage is still some time away in the Itasca Park program.

9.32 Implementation of an active management program.

All evidence collected to date indicates that some steps will need to be taken soon in order to insure preservation of pre-settlement biotic communities in the park. It is obvious that we cannot simply return to the natural situation of periodic wildfires allowed to burn when and wherever they occur. There are many ecological, sociological, political, and economic reasons which preclude this possibility. The next most likely alternative is to allow wildfires to burn naturally for certain distances and time periods before controlling them. However, our only current cause of natural fire is lightning. Indians are no longer a factor. Consequently, the burns would occur less frequently than natural. Should we accept fires caused by modern man as "natural" too?

Our surface vegetation and debris situation is

now such that a fire, even a natural one, might hav a quite unnatural impact on the park. In addition, many portions of the park have been so changed by logging that restoring the fire factor alone would not be sufficient to restore natural biotic communi ties.

All of these considerations tend to cast some doubt on the immediate use of wildfire, even under a controlled situation. A more likely opportunity exists for the simulation of natural fires with pre scribed burning. Such a technique has been applied in Everglades National Park (Robertson, 1953).and is currently being attempted on a trial basis in Sequoia-Kings Canyon National Park (U. S. Departmen of the Interior, 1968). Prescribed burning approximates the effect of natural wildfire with few of tl inherent dangers. It is probably the easiest technique to explain to the people, since it closely resembles a natural factor.

Other alternatives for manipulating park environments are cutting and herbicides. These technique are potentially useful tools, but perhaps much more difficult to reconcile within a park or wilderness area. They are the furthest removed from natural di turbance by fire.

Implementation of an active management program will depend on more than just the acquisition of additional ecological knowledge. It will be necessary to develop a strong and well-documented case for actively manipulating what the general public considers to be "untouched natural environments." We will need to present ecological evidence as to the need for manipulation. In order to gain public support we must be able to demonstrate that the programs we propose will indeed result in a more natural "vignette of primitive America."

LITERATURE CITED

Aldous, S. E. and L. W. Krefting

1946. The present status of moose on Isle Royale. Transactions, 11th No. American Wildlife Conference, pp. 296-308.

Ahlgren, I. F. and C. E. Ahlgren

1960. Ecological effects of forest fires. The Botanical Review 26(4):483-533.

Binford, L. C.

1963. (Comments on the Leopold Report). The Living Wilderness 83:22-23.

Biswell, H. H.

1959. Man and fire in ponderosa pine in the Sierra Nevada of California. Sierra Club Bulletin 44(7):44-53.

1961. The big trees and fire. Sierra Club Bulletin 35(163):11-14.

Blewett, M. B. and J. E. Potzger

1950. The forest primeval in Marion and Johnson Counties, Indiana. Butler University Botanical Studies 10:40-52.

Bourdo, E. A., Jr.

1956. A review of the General Land Office survey and of its use in quantitative studies of former forests. Ecology 37(4):754-768.